



Water Quality Monitoring at Roosevelt-Vanderbilt National Historic Sites

Northeast Temperate Network 2011 Summary Report

Natural Resource Data Series NPS/NETN/NRDS—2012/321



ON THE COVER

Measuring stream flow (discharge) at Fall Kill, July 2011

Photograph by: Bill Gawley

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Introduction

This report on the water quality of Roosevelt-Vanderbilt National Historic Sites (ROVA) generated by the Northeast Temperate Network (NETN) Water Quality Monitoring Program includes data gathered in the 2011 monitoring season and displays these results in graphic form, accompanied by a brief interpretation. Appendix A contains data collected from 2006 through 2011.

The vital signs for freshwater bodies included in the NETN Freshwater Monitoring Protocol (Lombard et al. 2006) are water chemistry, nutrient enrichment, water quantity, and the detection of invasive plant species. These metrics were chosen to address the NPS Inventory and Monitoring Program objective to detect change in the status of physical, chemical, or biological attributes of the ecosystem.

The NETN Freshwater Monitoring Protocol calls for a total of six park streams to be sampled monthly from May through October. A cooperator from the University of Vermont or a NETN hydrologic technician measured physical and in-situ water chemistry parameters each month and periodically collected water samples for analysis at the University of Maine's Sawyer Environmental Chemistry Research Laboratory. All monitoring data are incorporated into a series of comprehensive databases that ultimately feed the U.S. Environmental Protection Agency's "STORET" data system, the repository for all NPS water quality and quantity data.

Sampling Sites

Vanderbilt Mansion National Historic Site (VAMA), Eleanor Roosevelt National Historic Site (ELRO), and the Home of Franklin D. Roosevelt National Historic Site (HOFR) are commonly grouped together as the Roosevelt-Vanderbilt National Historic Sites (ROVA). Primarily managed to preserve and interpret cultural resources, these national historic sites exhibit a regionally-important array of water resources including 4.35 miles of streams, 13.75 acres of ponds, 38.8 acres of freshwater wetlands, 25 acres of tidal freshwater wetlands, and 1.1 miles of frontage along the lower Hudson River all contained within 682 acres (National Park Service 1997).

All of the basic field water-chemistry parameters and nutrients identified by the vital signs program have been collected intermittently since 1994 at 11 stations in ROVA (National Park Service 1997). Beginning in 2006, six sites were monitored at ROVA for the NETN long-term monitoring program (Table 1, Figure 1). These include five of the original 11 sites mentioned above, as well as an additional site established on the stream in the 2007 HOFR land acquisition. Sites were chosen to represent the major streams in each park unit (Lombard et al. 2006). All sites are considered capable of supporting warm-water fisheries (bass, sunfish, etc.).

Table 1. Water quality monitoring sites at Roosevelt-Vanderbilt NHS.

Water Body	NETN Site Code	Latitude	Longitude	Site Remarks
Lower FDR Brook ("Stream A")	ROVASA	41.7642	-73.93975	Historic site HOFR-3
Upper FDR Brook ("Stream B")	ROVASB	41.77	-73.9383	Historic site HOFR-1
Upper Crum Elbow Creek ("Stream C")	ROVASC	41.7955	-73.9391	Historic site VAMA-1
Lower Crum Elbow Creek ("Stream D")	ROVSD	41.7888333	-73.9455833	Historic site VAMA-3
Maritje Kill ("Stream E")	ROVASE	41.76286667	-73.9204667	Site established in 2007
Fall Kill ("Stream F")	ROVASF	41.7622833	-73.8996333	Historic site ELRO-3; downstream of upper Val-Kill Pond

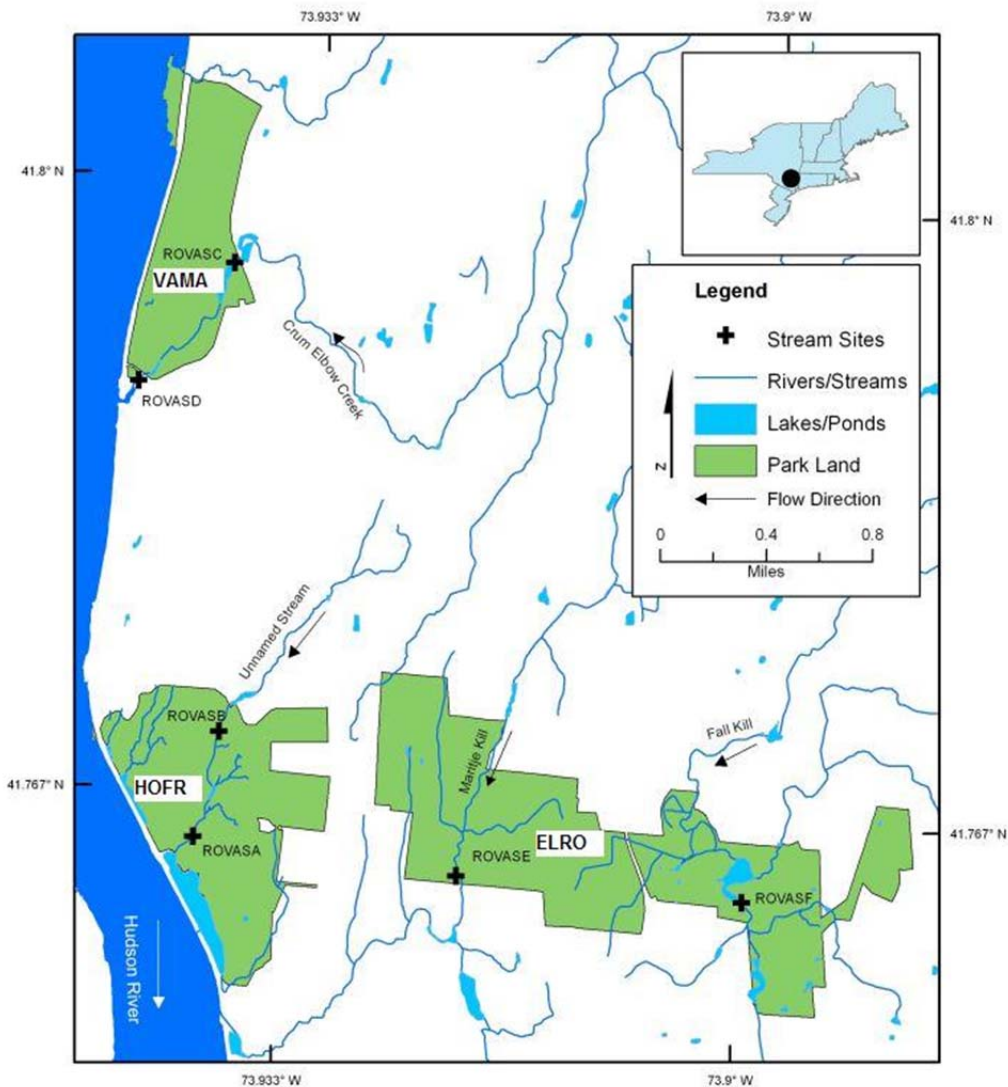


Figure 1. NETN water monitoring sites at Roosevelt-Vanderbilt NHS.

Methods

Detailed descriptions of all monitoring methods are found in the protocol (Lombard et al. 2006). Monthly sampling parameters included in-situ water quality measures (pH, specific conductance, temperature, and dissolved oxygen) determined with a YSI 600XL sonde, weather, stream flow (discharge), and stream stage (water level). Water samples obtained in May and August were analyzed for acid neutralizing capacity (ANC), color, and nutrients. Nutrient chemistry parameters were analyzed from a half-meter grab sample.

Stream discharge was measured using U.S. Geological Survey protocols (Rantz et al. 1982), employing a measuring tape, wading rod, and SonTek FlowTracker current meter (a Price Pygmy current meter was used at Maritje Kill [Stream E] in July and August 2011) to measure a particular cross-sectional area of the stream and the velocity of the water at that cross section.

In-situ stream water chemical and physical measurements and water samples were collected within 5 meters from the location of the discharge measurement. Sonde measurements were taken in the main stream flow with care taken that the sonde was not resting directly on the stream bottom. Grab samples were obtained by submerging the sample bottle directly in the stream with a gloved hand. A peristaltic pump and Tygon tubing were used to collect samples if water levels were too low to completely submerge a bottle.

Water Quality Standards

New York's Surface-Water Quality Standards (New York State Department of Environmental Conservation 1999) designates Class AA as the most restrictive stream classification for water quality. "Class AA waters shall have no change in color that will cause a substantial visible contrast to natural conditions, and shall have no phosphorus and nitrogen that will result in algae, weed, and slime growth that will impair the waters for their best usages. The pH shall range from 6.5 to 8.5. DO concentrations shall not be less than 7.0 mg/L for other than natural conditions in cold waters suitable for trout spawning. The minimum average daily DO concentration for trout waters shall not be less than 6.0 mg/L and at no time shall the concentration be less than 5.0 mg/L. The minimum average daily DO concentration for non-trout waters shall not be less than 5.0 mg/L, and at no time shall the DO concentration be less than 4.0 mg/L" (New York State Department of Environmental Conservation 1999).

EPA Ecoregion 7 water quality criteria (Table 2; U.S. Environmental Protection Agency 2000) are also used as a benchmark in this report. EPA water quality criteria for nutrients help translate narrative criteria within State or Tribal water quality standards by establishing values for causal variables (e.g., total nitrogen and total phosphorus) and response variables (e.g., turbidity and chlorophyll *a*). Causal variables are necessary to provide sufficient protection of designated uses before impairment occurs and to maintain downstream uses. Early response variables are necessary to provide warning signs of possible impairment and to integrate the effects of variable and potentially unmeasured nutrient loads (U.S. Environmental Protection Agency 2002).

Table 2. EPA Ecoregion 7 nutrient criteria for streams.

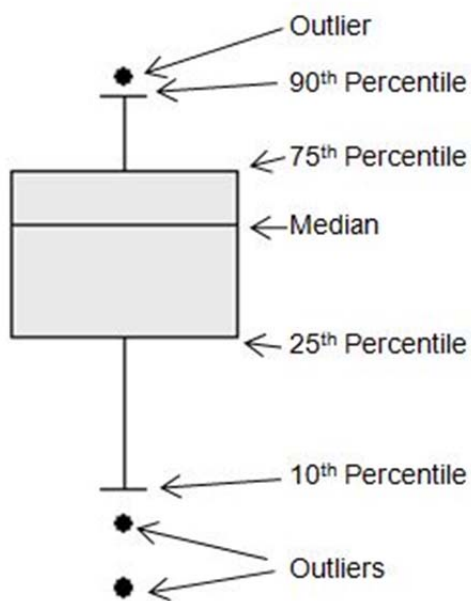
Nutrient Criteria	Value
Total Phosphorus	33 µg/L
Total Nitrogen	0.54 mg/L

These criteria were developed specifically for Ecoregion 7 (which includes both NETN parks in New York) and are designed to represent conditions of surface waters that are minimally impacted by human activities and thus protect against the adverse effects of nutrient over-enrichment from cultural eutrophication. The values are EPA's scientific recommendations regarding ambient concentrations of nutrients that protect aquatic resource quality. They do not have any regulatory impact or meaning.

The criteria were established based on the lower 25th percentile of streams for which the EPA found data. This percentile of all streams is expected to approximately correspond to the 75th percentile of reference (undisturbed) streams. In other words, 75% of streams in the ecoregion do not meet the criteria, nor do roughly 25% of reference streams. (U.S. Environmental Protection Agency 2000).

Results

Monitoring results for 2011 are displayed in scatter-plot graphs showing all data for each site for a given parameter. The scatter plots of 2011 data are overlaid on box plots representing the



overall range and distribution of data values collected from 2006 through 2011 for the specified parameter and site (Appendix A contains all data in tabular form). A box plot (Figure 2) is a summary plot that graphs data as a box representing statistical values. The boundary of the box closest to zero indicates the 25th percentile, a line within the box marks the median, and the boundary of the box farthest from zero indicates the 75th percentile. Whiskers (error bars) above and below the box indicate the 90th and 10th percentiles respectively. Outliers are displayed as black filled circles. If EPA or other water quality criteria exist for a particular parameter they are displayed on the graphs as specification lines.

Figure 2. Explanation of box plot graph.

Water Quality

Measures of water quality include specific conductance, pH, water temperature, dissolved oxygen (DO), acid neutralizing capacity (ANC), and apparent color. Assessment of water quality data aids in the interpretation of the biotic condition and ecological processes of surface water resources.

Specific Conductance

Specific conductance (Figure 3) is a measure of the ability of water to carry an electrical current, and is directly related to the level of dissolved ions in the water. An increase in specific conductance can be an indicator of pollutants in the water.

Naturally occurring values range from less than 20 to more than 1,000 microsiemens per centimeter ($\mu\text{S}/\text{cm}$). Specific conductance values from 2011 were within the appropriate range for high ionic strength waters, and were similar to the median values shown on the box plot. July specific conductance values for both FDR Brook sites fell in the upper range of variability.

Specific Conductance (ROVA, 2011)

The figure is a box plot titled "Specific Conductance (ROVA, 2011)". The y-axis is labeled "Specific conductance ($\mu\text{S}/\text{cm}$)" and ranges from 100 to 900 in increments of 100. The x-axis lists six streams: Stream A, Stream B, Stream C, Stream D, Stream E, and Stream F. Each stream has a box plot representing the 25th to 75th percentile range from 2006-2011. Overlaid on these box plots are specific conductance measurements from 2011 for May, June, July, August, September, and October. The legend indicates the following symbols for the 2011 measurements: May (yellow triangle), June (cyan inverted triangle), July (magenta square), August (green diamond), September (blue square), and October (grey circle). Stream A (Lower FDR Brook) has a median around 600 $\mu\text{S}/\text{cm}$. Stream B (Upper FDR Brook) has a median around 680 $\mu\text{S}/\text{cm}$. Stream C (Upper Crum Elbow Creek) has a median around 400 $\mu\text{S}/\text{cm}$. Stream D (Lower Crum Elbow Creek) has a median around 430 $\mu\text{S}/\text{cm}$. Stream E (Maritje Kill) has a median around 580 $\mu\text{S}/\text{cm}$. Stream F (Fall Kill) has a median around 460 $\mu\text{S}/\text{cm}$. The 2011 measurements generally fall within the 2006-2011 range, with July values for Stream A and Stream B being notably higher than the median.

Specific conductance ($\mu\text{S}/\text{cm}$)

Stream A Stream B Stream C Stream D Stream E Stream F

25th - 75th percentile range 2006-2011
May 2011
June 2011
July 2011
August 2011
September 2011
October 2011

Stream A: Lower FDR Brook
Stream B: Upper FDR Brook
Stream C: Upper Crum Elbow Creek
Stream D: Lower Crum Elbow Creek
Stream E: Maritje Kill
Stream F: Fall Kill

Figure 3. Specific conductance from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.

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pH Level

The pH of a water body reflects how acidic or basic the water is, measured on a scale of 1 to 14, with 7 being neutral. Acid waters are below 7, and alkaline waters are above 7. A one-unit change in pH represents a 10-fold change in acidity or alkalinity. New York standards, like those of most northeast states, indicate that a pH between 6.5 and 8.5 is within the acceptable range. pH values from the 2011 monitoring season (Figure 4) were basic, and were all between the upper and lower New York water quality standards.

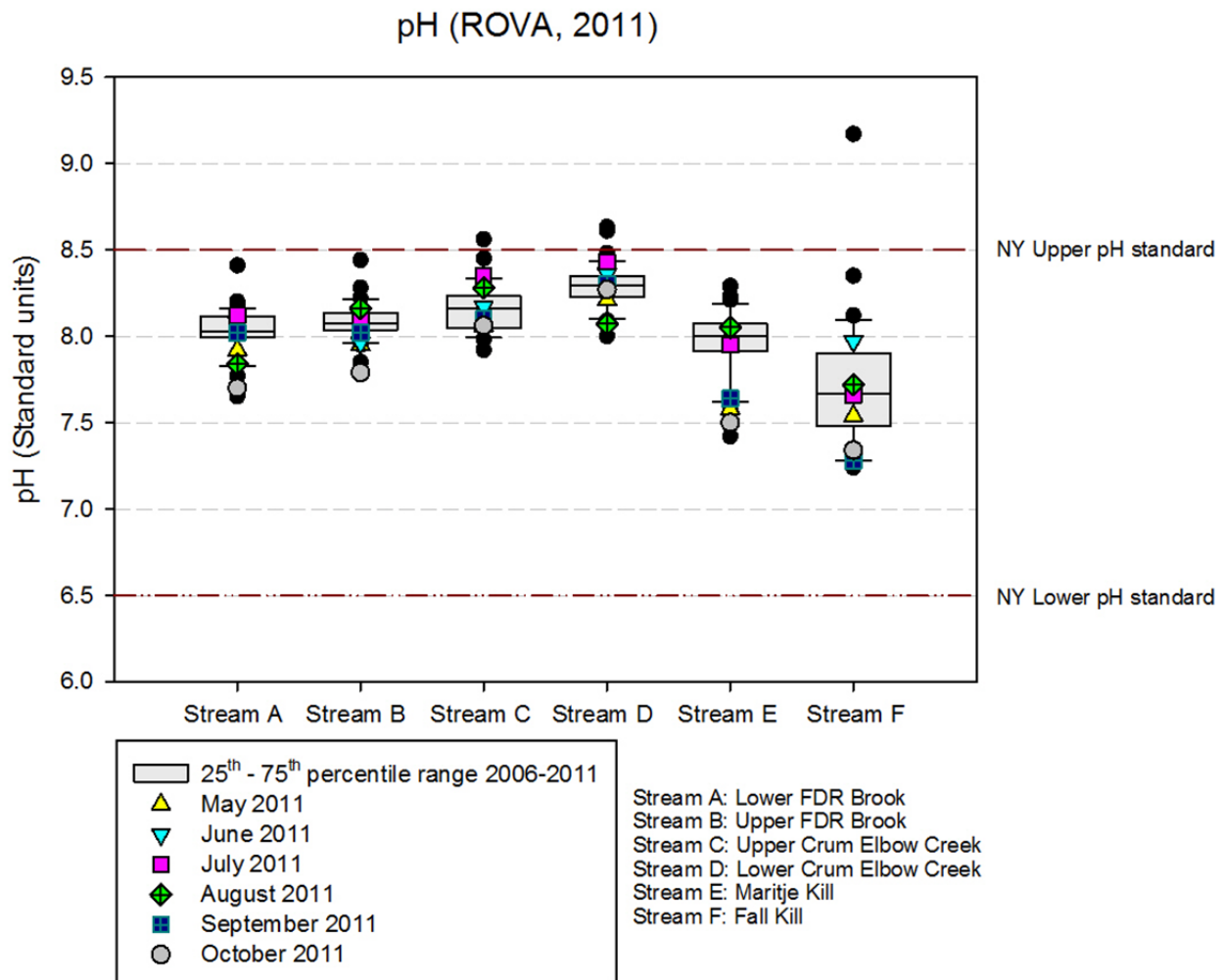


Figure 4. pH from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.

Temperature

Temperature can affect water chemistry and biology. For example, the amount of oxygen that water can hold is directly related to the temperature of the water. The higher the temperature, the less oxygen water can hold, which can be observed in both diel (day and night) and seasonal shifts. Oxygen will naturally decline during the summer months as water temperatures rise. Temperature can also determine the kinds of plants and animals found in the lake or pond. Certain species of fish, insects, and algae will predominate during the cooler temperatures of the spring and fall, yet be less apparent during the warmer temperatures of summer. Surface water temperatures (Figure 5) appeared to be within the normal range of variability in 2011, though some of the July and August values from the less shaded sites reflected the contributions of high air temperature and solar radiation.

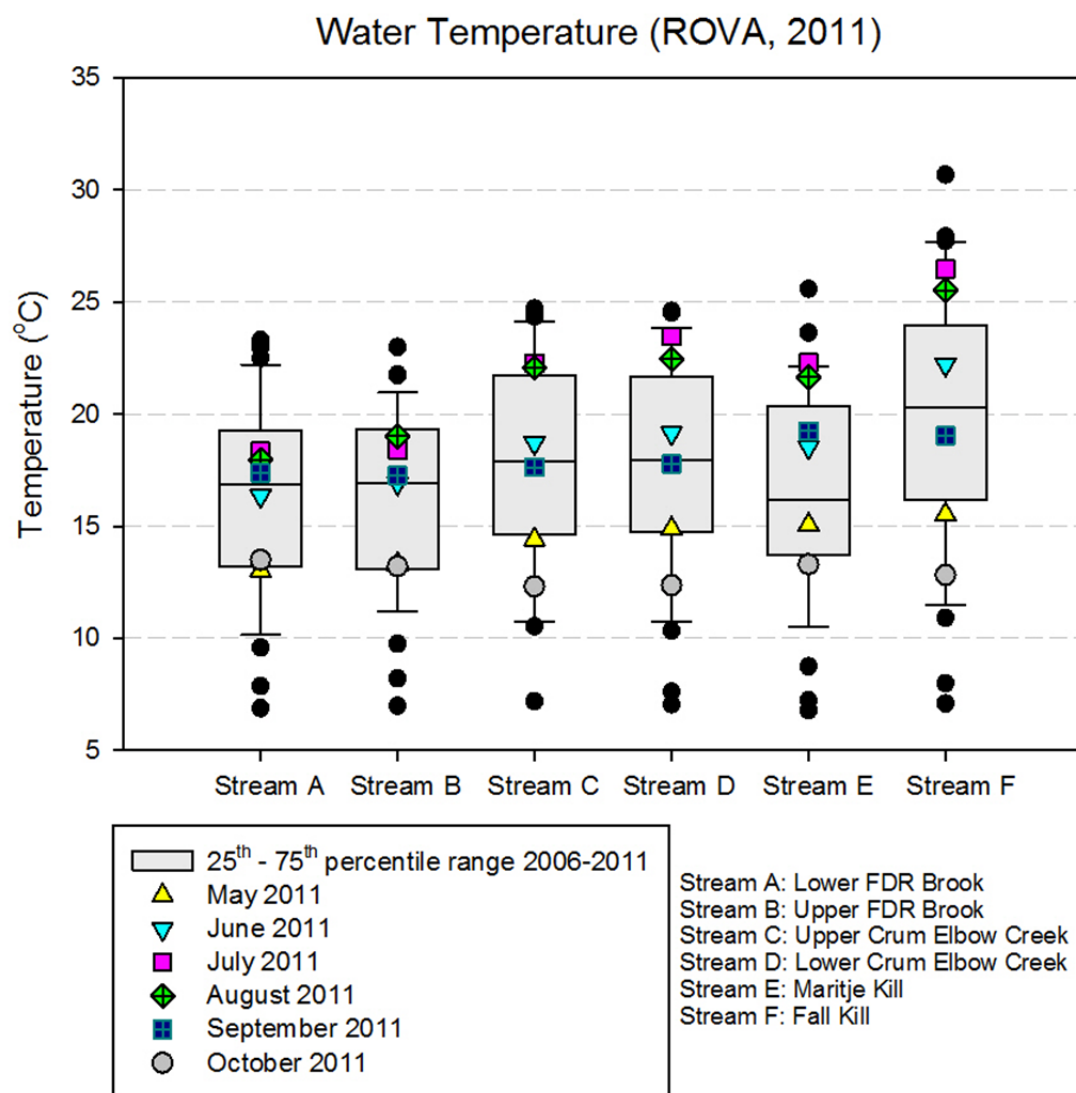


Figure 5. Water temperature (surface) from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.

Dissolved Oxygen

Dissolved oxygen (DO) is a critical indicator of water quality because aquatic life generally needs DO concentrations at or above 5 mg/L to thrive. Low oxygen can directly kill or stress organisms such that they will not be able to successfully reproduce or grow. Water with less than 1 part per million (ppm) of oxygen is considered anoxic (no oxygen present). All ROVA sites were well oxygenated in 2011 (Figure 6), and were above the most stringent (7 mg/L) state DO standard (except for the October 2011 measurement at Fall Kill [Stream F]).

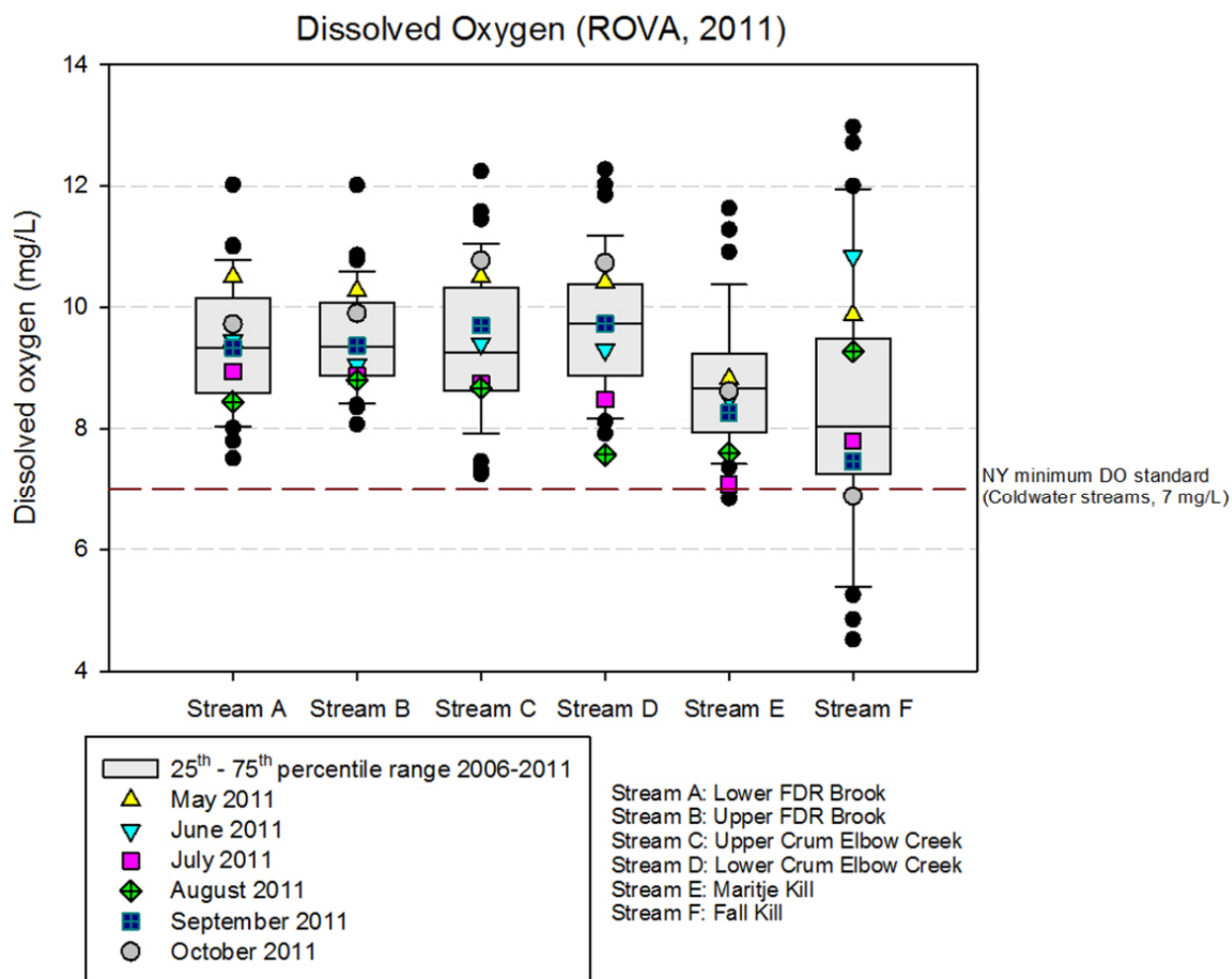


Figure 6. Dissolved oxygen (surface) from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.

Acid Neutralizing Capacity

Acid neutralizing capacity (ANC) is also known as alkalinity, or buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate, and hydroxide ions, with bicarbonate being the major form. Most states do not have numerical criteria for ANC in their water-quality standards. ANC values greater than 100 $\mu\text{eq/L}$ are considered well-buffered, while values less than zero typify acidic waters (Stoddard et al. 2003). Acid neutralizing capacity measured in the 2011 samples (Figure 7) illustrates that ROVA streams were very well-buffered, likely due to the underlying geology. The May (Spring) 2011 ANC measurements from all streams were the lowest in the NETN data history at ROVA. These values, along with lower May pH values, may illustrate the effects of episodic acidification from spring snowmelt and runoff (as well as the ability of the robust ANC to counteract the acidification pulses).

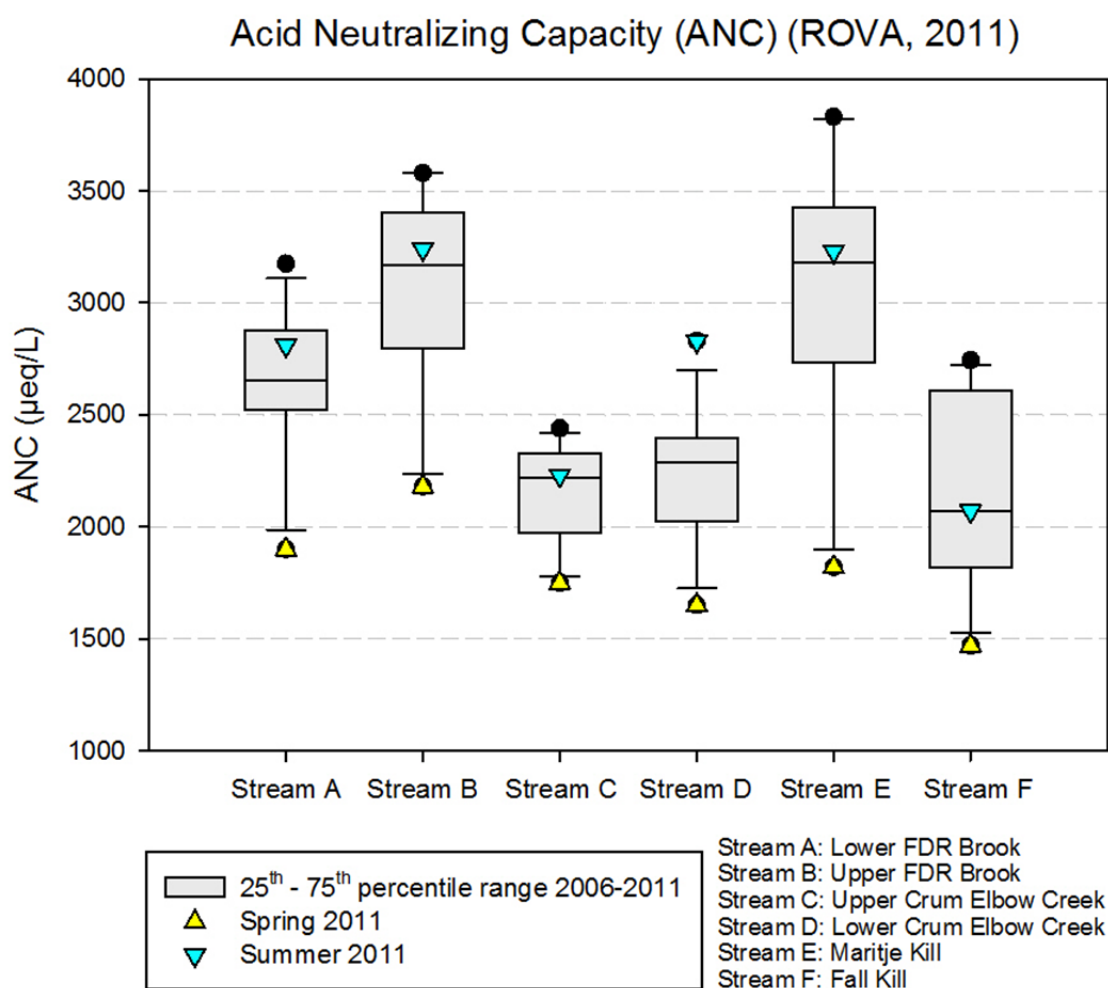


Figure 7. Acid neutralizing capacity from 2011 spring and summer water samples overlaid on a box plot of measurements taken from 2006-2011.

Apparent Color

Color in pond and stream water is caused by natural metallic ions, humus and peat materials, plankton, weeds, and industrial wastes. Color is reported in Pt-Co units (PCU). True color is the color measurement of water from which suspended particles have been removed by filtration. Apparent color (the measurement method utilized by the NETN) is determined on original samples without filtration. Color can be a rough indicator for organic acidity.

Water bodies with apparent color values of greater than 25 PCU are considered to be highly colored, and often exhibit reduced water clarity and high phosphorus concentrations. Values of color are usually not included in water quality standards, except to note that they should be as naturally occurs.

Median color values from 2006 to 2011 monitoring (Figure 8) show most ROVA streams to be moderately colored. The highly elevated color measured in the May (Spring) 2011 samples further indicates the possibility of substantial runoff input to the streams prior to the May monitoring visit, especially since the samples were not filtered before analysis. Monthly turbidity measurements, which will begin in 2012, may provide additional information on the impacts to ROVA streams from episodic runoff events.

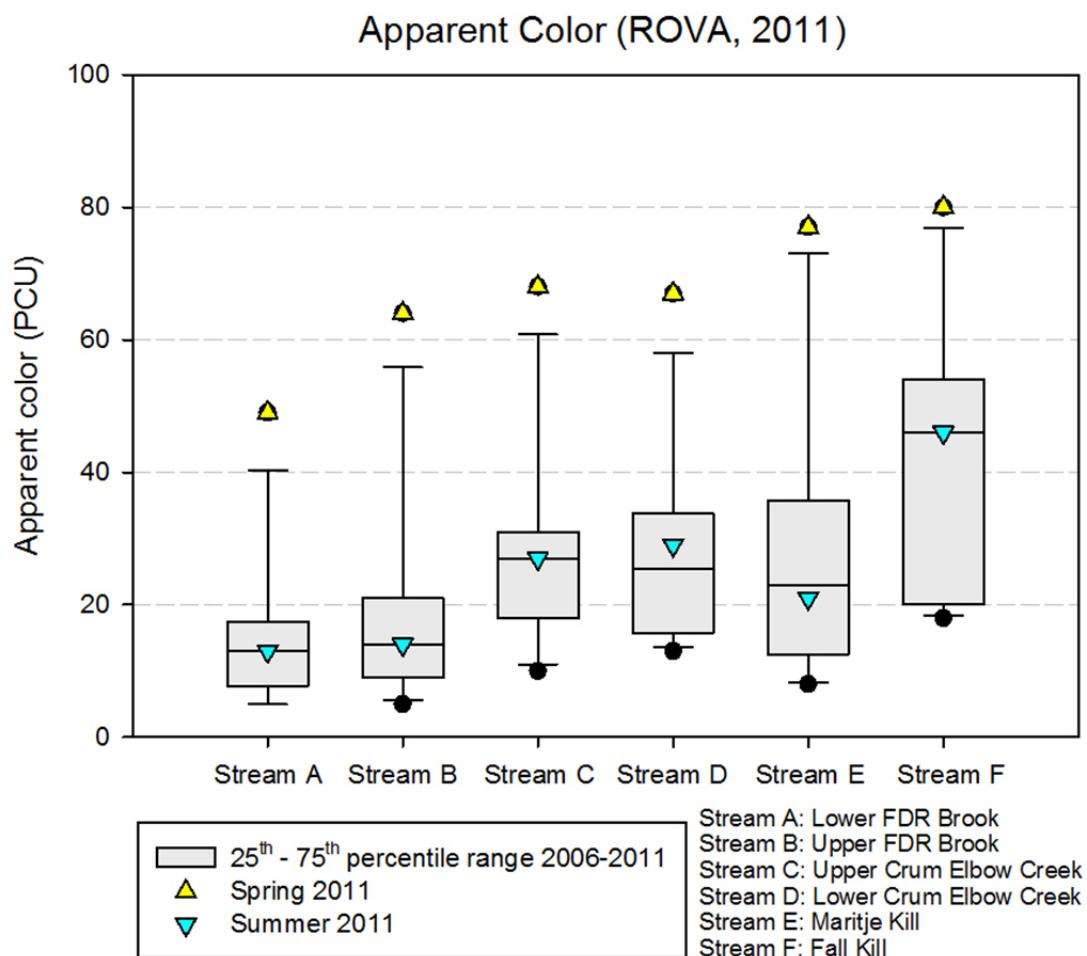


Figure 8. Apparent color from 2011 spring and summer water samples overlaid on a box plot of measurements taken from 2006-2011.

Nutrient Enrichment

Nutrient enrichment and the acceleration of eutrophication have been identified in most NETN parks as one of the stressors of greatest concern. Several forms of total and dissolved phosphorus and nitrogen are measured to give managers information regarding the trophic status and productivity of freshwater systems.

Phosphorus

Phosphorus (P) is one of the major nutrients needed for plant growth. It is generally present in small amounts and limits the plant growth in streams and ponds. Several forms of phosphorus were tested individually. Total phosphorus (TP) is a measure of both inorganic and organic forms of phosphorus, and is the common water quality standard or criteria metric. Phosphorus can be present as dissolved or particulate matter, and filtered samples were analyzed for total dissolved phosphorus (TDP). Soluble reactive phosphorus (SRP, or “orthophosphate”) is a measure of the inorganic oxidized form of soluble phosphorus. This form of phosphorus is the most readily available for uptake during photosynthesis. High concentrations of SRP generally occur in conjunction with algal blooms.

In 2011, all phosphorus concentrations (Figure 9) were moderately high, and generally showed the expected seasonal variation of lower spring values. The Fall Kill measurements were highest of all the sites, likely due to the upstream influence of Val Kill Pond. All TP values exceeded EPA Region 7 criterion of $33\mu\text{g/L}$. As described above (“Water Quality Standards”), the EPA criteria do not have any regulatory meaning.

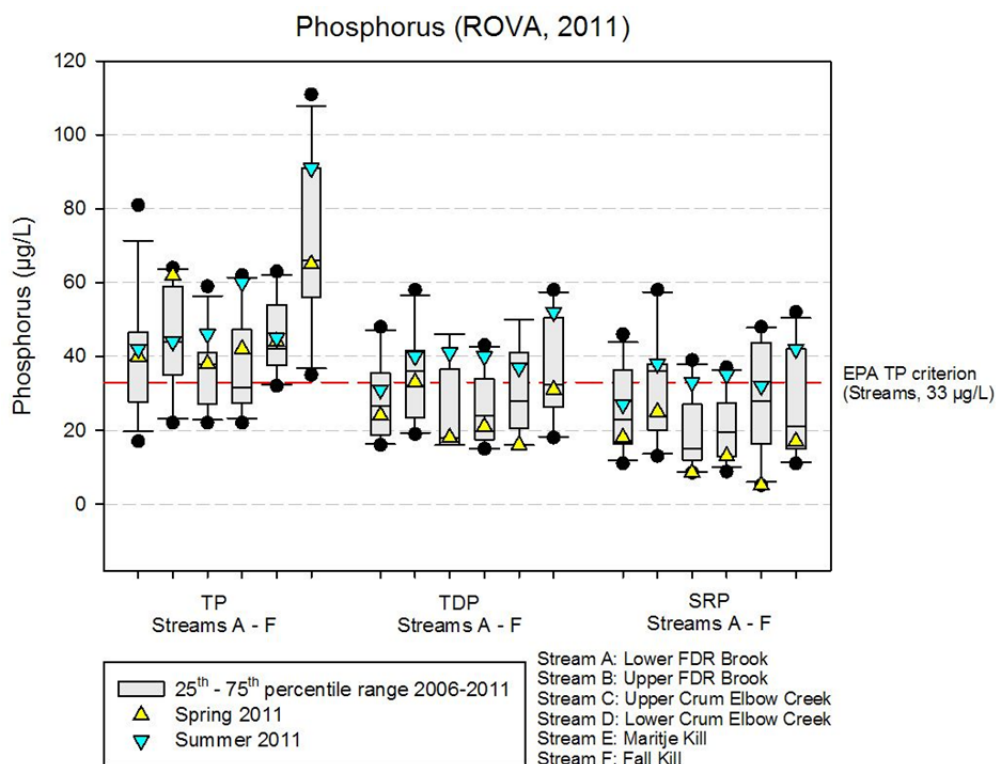


Figure 9. Total phosphorus (TP), total dissolved phosphorus (TDP), and soluble reactive phosphorus (SRP) from spring and summer water samples. The data are overlaid on a box plot of measurements taken from 2006-2011.

Total Nitrogen

Total nitrogen (TN) is a measure of all forms of nitrogen (organic and inorganic). Nitrogen is an essential plant element and is often the limiting nutrient in marine waters, and it can also limit some freshwater systems. Filtered samples were analyzed for total dissolved nitrogen (TDN). The importance of nitrogen in the aquatic environment varies according to the relative amounts of the forms of nitrogen present, including nitrate, nitrite, and ammonia.

Test results for several forms of nitrogen are shown in Figure 10. Most TN values exceeded the EPA Region 9 criterion of 0.54 mg/L, although as with TP this criterion does not have regulatory meaning. Summer TN and TDN results from both FDR Brook sites were in excess of 2.0 mg/L, the value used as a TN standard in several northeast states (New York has no numeric TN standard). Nitrate (NO_3) is the most oxidized and stable form of nitrogen in a water body, and is the primary form of nitrogen used by plants as a nutrient. Nitrite (NO_2) is an unstable form of nitrogen that is either rapidly oxidized to nitrate (nitrification) or reduced to nitrogen gas (denitrification). This form of nitrogen can also be used as a source of nutrients for plants. NETN water samples were analyzed with a combined test for nitrate and nitrite, and most results (excepting the spring FDR Brook samples) were relatively low. Nitrite concentrations were very low, with several test results below the method reporting limit of 0.005 mg/L. All ammonia (NH_3 , another inorganic, bioavailable form of concern) test results were below the method reporting limit of 0.08 mg/L.

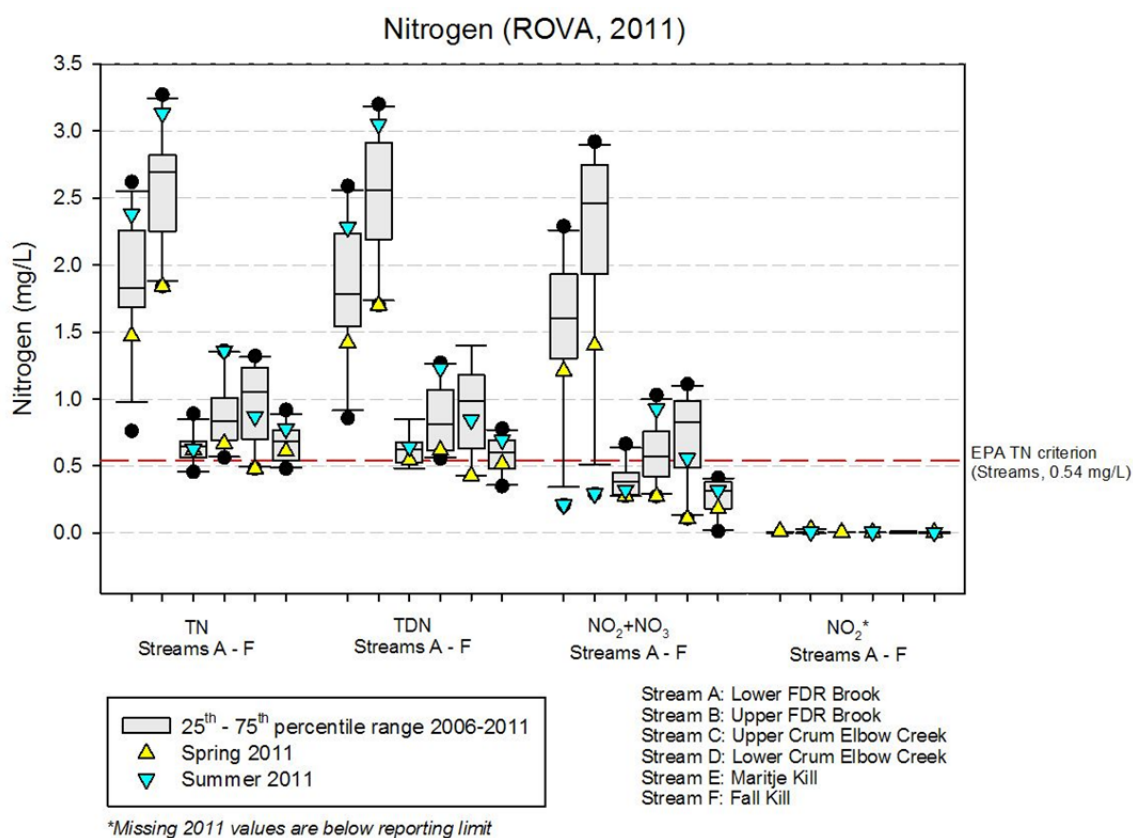


Figure 10. Total nitrogen (TN), total dissolved nitrogen (TDN), nitrite + nitrate ($\text{NO}_2 + \text{NO}_3$), and nitrite (NO_2) from 2011 spring and summer water samples. The data are overlaid on a box plot of measurements taken from 2006-2011.

Water Quantity

Monthly stream discharge measurements, taken with a current meter and wading rod, can be used to calculate loading of nutrient chemical constituents (flow times concentration), and also provide a record of variations in stream flow. Stream stage (height of water) measurements can be paired with discharge values and over time a stage to discharge relationship can be calculated. Once this relationship is established, investigators can interpolate the stream discharge from the stage measurement alone. Numerous discharge measurements at all ranges of streamflow are required to establish and maintain an accurate stage to discharge relationship. Stream stage measurements from 2011 are graphed in Figure 11. Discharge and stage measurements from 2006 to 2011 are listed in Table A3 in Appendix A.

Stream flow followed the expected seasonal sequence of high discharge in May to minimal flow in July and August, with gradual recovery in September and October. NETN staff are currently reviewing discharge and stage measurement methodology and quality assurance/quality control procedures in order to enhance the quality and utility of the water quantity data. A stage to discharge relationship graph will be produced once sufficient data are collected.

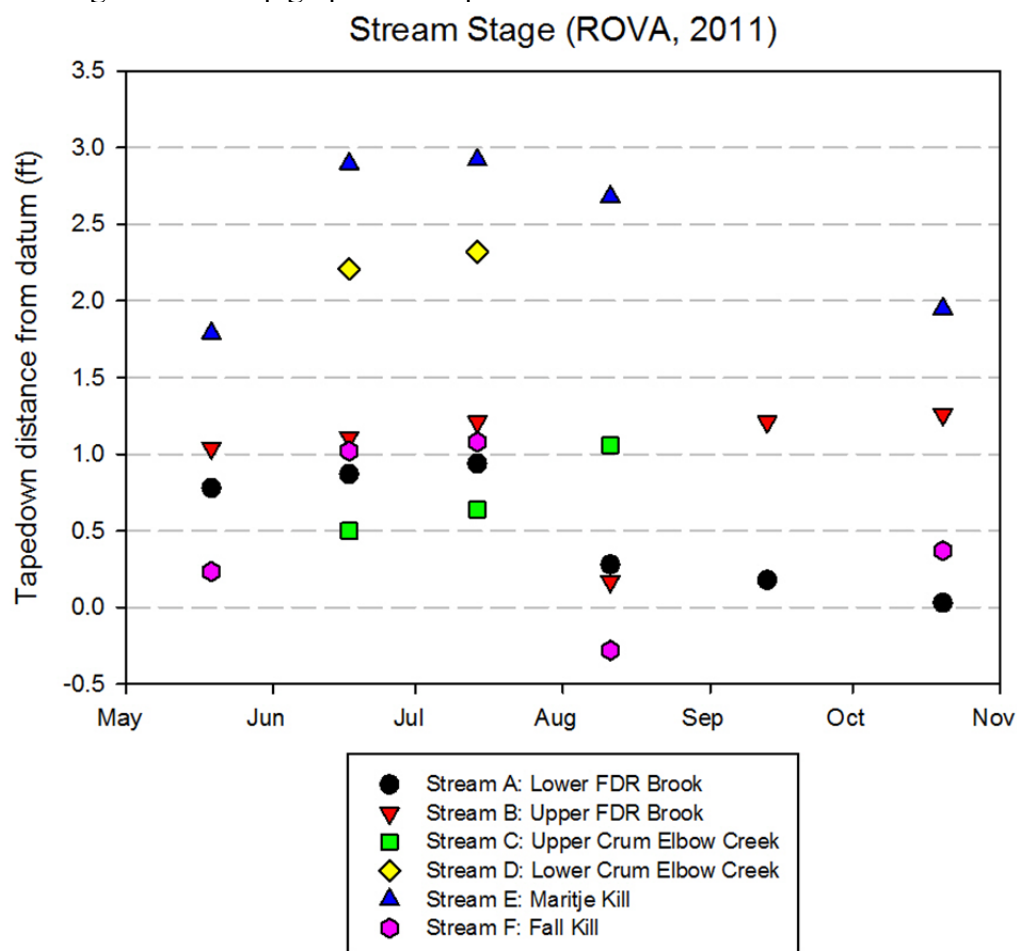


Figure 11. Stream stage obtained in 2011 by measuring from a permanent datum point down to the water surface. *Note: Larger tapedown distances indicate LOWER water levels. Negative measurements indicate datum was below water surface.*

Invasive Aquatic Plants

Invasive aquatic plant monitoring was not conducted at ROVA during the 2011 monitoring season, since the protocol specifies that targeted invasive aquatic plant monitoring is only conducted at pond and lake sites. However, during future visits to all NETN parks, monitoring crews will be increasingly attentive for the presence of Didymo (*Didymosphenia geminata*), also known as “rock snot”, a highly invasive alga that has recently invaded the northern reaches of the Connecticut River in New Hampshire and in the White River and Battenkill River in Vermont. This species has a great potential to alter habitats and displace native species, and is of great concern to officials in regions where infestations have been established.

Didymo is easily spread by even just one cell of the alga breaking off and drifting downstream in infested reaches. It is also very easily spread by waders, and potentially, water monitoring equipment and other gear that touches the bottoms of streams in infested areas. Enhanced equipment cleaning and decontamination procedures are being included in the latest NETN monitoring protocol revision.

The early detection of an invasive plant infestation can make eradication or control more feasible, and it can lead to efforts that reduce the spread of the plant to neighboring water bodies. Designating the early detection of these plants as a NETN vital sign and the ongoing partnership with state and local monitoring and eradication efforts are highly effective prevention strategies.

Summary

Most water quality parameters for the streams monitored in the Roosevelt-Vanderbilt National Historic Sites are within state standards, and are generally within the range of EPA criteria, where applicable. The majority of values are within the ranges of the historic NETN monitoring data from ROVA, although May apparent color levels at all sites were the highest reported to date. ANC measurements showed that all streams were very well-buffered, however May ANC values were also the lowest in the NETN data history at ROVA. Consideration of the ANC and color result sets suggests that there may have been a substantial precipitation and runoff event preceding the May sample visit, contributing acidity and sediment to the stream water. Fortunately, the naturally high ANC of ROVA streams provided sufficient buffering to avoid depressed pH values.

Phosphorus levels are historically in the moderate to high range, and most 2011 TP results were slightly above the EPA Region 7 criterion value (33µg/L). The Fall Kill site, just downstream of Upper Val Kill Pond, had the highest phosphorus measurements of all the ROVA sites. This is likely due to the contribution of the higher nutrient loads in the pond water. Nitrogen levels, especially TN, TDN, and NO₃ were very high in August samples from both of the FDR Brook sites. Results for these three forms of nitrogen were moderately high in the remainder of the streams, and NO₂ was low at all sites. All ammonia (NH₃) test results were below the method reporting limit of 0.08 mg/L.

Monitoring under the NETN protocol builds on the historic water quality monitoring by park staff to provide critical baseline information on the chemical and physical status of the water resources Roosevelt-Vanderbilt National Historic Sites. Several changes will be implemented in the 2012 monitoring season, including taking monthly stream turbidity measurements, and the

addition of sulfate, chloride, and dissolved organic carbon (DOC) analyses to the spring and summer water chemistry testing. These changes will expand the scope and usefulness of the monitoring data. As more data are collected, the ability to detect changes outside this natural range of variability will increase, which in turn will more clearly indicate the status of the vital signs of water quality, nutrient enrichment, water quantity, and the detection of invasive plant species.

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Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011.

Table A1. YSI sonde in-situ water quality measurements collected at ROVA.

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Sp Cond (uS/cm)
Lower FDR Brook (Stream A)	5/24/2006	0.01	14.73	10.35	8.28	296
Lower FDR Brook (Stream A)	5/24/2006	0.36	10.29	10.72	8.11	492
Lower FDR Brook (Stream A)	6/21/2006	0.33	17.34	9.16	8.08	580
Lower FDR Brook (Stream A)	7/18/2006	0.25	23.30	8.04	8.06	589
Lower FDR Brook (Stream A)	8/16/2006	0.33	19.98	8.86	8.11	633
Lower FDR Brook (Stream A)	9/20/2006	0.14	16.83	9.17	8.14	572
Lower FDR Brook (Stream A)	10/18/2006	0.13	12.17	10.15	7.95	532
Lower FDR Brook (Stream A)	4/18/2007	0.57	6.88	12.02	7.96	388
Lower FDR Brook (Stream A)	5/23/2007	0.35	13.35	10.50	8.20	554
Lower FDR Brook (Stream A)	6/13/2007	0.30	17.22	9.04	8.13	605
Lower FDR Brook (Stream A)	7/11/2007	0.16	22.12	8.20	8.01	610
Lower FDR Brook (Stream A)	8/7/2007	0.23	22.49	8.01	8.01	639
Lower FDR Brook (Stream A)	9/5/2007	0.30	18.55	8.99	7.77	644
Lower FDR Brook (Stream A)	10/2/2007	0.15	16.09	9.34	8.00	656
Lower FDR Brook (Stream A)	5/14/2008	0.44	10.77	10.71	8.12	572
Lower FDR Brook (Stream A)	6/12/2008	0.23	20.20	8.37	8.00	642
Lower FDR Brook (Stream A)	7/18/2008	0.19	20.35	8.37	8.02	658
Lower FDR Brook (Stream A)	8/26/2008	0.21	18.06	9.10	8.12	662
Lower FDR Brook (Stream A)	9/18/2008	0.28	16.17	9.35	8.03	607
Lower FDR Brook (Stream A)	10/10/2008	0.40	12.03	10.14	8.07	675
Lower FDR Brook (Stream A)	5/13/2009	0.39	11.73	10.64	8.04	593
Lower FDR Brook (Stream A)	6/23/2009	0.42	17.03	9.38	7.98	486
Lower FDR Brook (Stream A)	7/29/2009	0.21	19.82	8.63	7.94	619
Lower FDR Brook (Stream A)	8/26/2009	0.12	21.12	8.53	8.00	582
Lower FDR Brook (Stream A)	9/22/2009	0.26	15.63	9.61	8.02	701
Lower FDR Brook (Stream A)	10/15/2009	0.22	7.87	11.00	8.41	477
Lower FDR Brook (Stream A)	5/12/2010	0.30	9.59	11.02	8.10	601
Lower FDR Brook (Stream A)	6/9/2010	0.21	14.95	9.39	8.15	647
Lower FDR Brook (Stream A)	7/21/2010	0.17	22.96	7.80	8.08	738
Lower FDR Brook (Stream A)	8/25/2010	0.28	18.70	7.51	7.65	475
Lower FDR Brook (Stream A)	9/15/2010	0.26	15.56	9.11	8.19	779
Lower FDR Brook (Stream A)	10/12/2010	0.24	13.98	9.63	8.01	712
Lower FDR Brook (Stream A)	5/19/2011	0.25	13.02	10.50	7.92	413
Lower FDR Brook (Stream A)	6/17/2011	0.25	16.34	9.45	8.08	613
Lower FDR Brook (Stream A)	7/14/2011	0.36	18.33	8.94	8.12	741
Lower FDR Brook (Stream A)	8/11/2011	0.35	17.96	8.44	7.84	656
Lower FDR Brook (Stream A)	9/13/2011	0.17	17.37	9.33	8.02	558
Lower FDR Brook (Stream A)	10/20/2011	0.19	13.49	9.72	7.70	501
Upper FDR Brook (Stream B)	5/24/2006	0.31	11.54	10.27	8.11	577
Upper FDR Brook (Stream B)	6/21/2006	0.33	18.40	8.88	8.14	441
Upper FDR Brook (Stream B)	7/18/2006	0.23	22.99	8.07	8.08	677
Upper FDR Brook (Stream B)	8/16/2006	0.28	19.79	8.92	8.06	685
Upper FDR Brook (Stream B)	9/20/2006	0.11	16.88	9.18	8.06	659
Upper FDR Brook (Stream B)	10/18/2006	0.04	12.37	10.15	8.05	538
Upper FDR Brook (Stream B)	4/18/2007	0.54	6.99	12.01	7.97	434
Upper FDR Brook (Stream B)	5/23/2007	0.35	13.49	10.15	8.15	643
Upper FDR Brook (Stream B)	6/13/2007	0.25	17.50	9.04	8.07	699
Upper FDR Brook (Stream B)	7/11/2007	0.16	21.73	8.39	8.16	700
Upper FDR Brook (Stream B)	8/7/2007	0.22	21.76	8.42	8.02	692
Upper FDR Brook (Stream B)	9/5/2007	0.25	17.87	9.21	7.97	707
Upper FDR Brook (Stream B)	10/2/2007	0.17	15.25	9.81	7.85	701
Upper FDR Brook (Stream B)	10/2/2007	0.17	15.25	9.81	7.85	701

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A1. YSI sonde in-situ water quality measurements collected at ROVA. (continued).

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Sp Cond (uS/cm)
Upper FDR Brook (Stream B)	5/14/2008	0.44	11.74	10.36	8.13	662
Upper FDR Brook (Stream B)	6/12/2008	0.20	20.46	8.35	8.06	717
Upper FDR Brook (Stream B)	7/18/2008	0.18	20.62	8.51	8.13	732
Upper FDR Brook (Stream B)	8/26/2008	0.19	17.48	9.36	8.22	753
Upper FDR Brook (Stream B)	9/18/2008	0.24	16.14	9.47	8.12	716
Upper FDR Brook (Stream B)	10/10/2008	0.31	12.44	10.01	8.11	778
Upper FDR Brook (Stream B)	5/13/2009	0.33	12.67	10.54	8.13	702
Upper FDR Brook (Stream B)	6/23/2009	0.29	17.94	9.09	8.03	548
Upper FDR Brook (Stream B)	7/29/2009	0.14	19.64	9.01	8.04	710
Upper FDR Brook (Stream B)	8/26/2009	0.12	20.24	8.56	8.08	683
Upper FDR Brook (Stream B)	9/22/2009	0.16	14.84	9.90	8.07	788
Upper FDR Brook (Stream B)	10/15/2009	0.15	8.21	10.78	8.44	759
Upper FDR Brook (Stream B)	5/12/2010	0.18	9.75	10.86	8.07	632
Upper FDR Brook (Stream B)	6/9/2010	0.19	15.00	9.53	8.20	723
Upper FDR Brook (Stream B)	7/22/2010	0.21	20.76	8.51	8.21	723
Upper FDR Brook (Stream B)	8/25/2010	0.20	18.58	8.94	8.06	668
Upper FDR Brook (Stream B)	9/15/2010	0.19	15.26	9.59	8.28	834
Upper FDR Brook (Stream B)	10/12/2010	0.19	12.97	9.98	8.04	788
Upper FDR Brook (Stream B)	5/19/2011	0.19	13.31	10.27	7.95	480
Upper FDR Brook (Stream B)	6/17/2011	0.16	16.90	9.05	7.96	506
Upper FDR Brook (Stream B)	7/14/2011	0.36	18.39	8.87	8.09	777
Upper FDR Brook (Stream B)	8/11/2011	0.30	19.01	8.80	8.16	502
Upper FDR Brook (Stream B)	9/13/2011	0.17	17.25	9.37	8.02	660
Upper FDR Brook (Stream B)	10/20/2011	0.19	13.21	9.90	7.79	561
Upper Crum Elbow Brook (Stream C)	5/24/2006	0.41	12.97	10.59	8.26	294
Upper Crum Elbow Brook (Stream C)	6/21/2006	0.27	21.33	9.11	8.31	330
Upper Crum Elbow Brook (Stream C)	7/18/2006	0.63	24.09	8.20	8.01	376
Upper Crum Elbow Brook (Stream C)	8/16/2006	0.39	20.07	8.87	8.02	409
Upper Crum Elbow Brook (Stream C)	9/20/2006	0.34	16.75	9.71	8.18	305
Upper Crum Elbow Brook (Stream C)	10/18/2006	0.14	10.81	10.95	8.21	351
Upper Crum Elbow Brook (Stream C)	4/18/2007	0.57	7.19	12.24	7.92	199
Upper Crum Elbow Brook (Stream C)	5/23/2007	0.46	14.80	10.28	8.20	371
Upper Crum Elbow Brook (Stream C)	6/13/2007	0.39	20.46	8.50	8.16	417
Upper Crum Elbow Brook (Stream C)	7/11/2007	0.34	24.64	7.33	7.98	423
Upper Crum Elbow Brook (Stream C)	8/8/2007	0.14	23.72	7.25	8.05	465
Upper Crum Elbow Brook (Stream C)	9/6/2007	0.37	19.08	8.91	8.07	484
Upper Crum Elbow Brook (Stream C)	10/3/2007	0.11	16.56	9.26	8.17	408
Upper Crum Elbow Brook (Stream C)	5/13/2008	0.44	15.44	9.95	8.33	354
Upper Crum Elbow Brook (Stream C)	6/12/2008	0.32	24.35	8.44	8.25	400
Upper Crum Elbow Brook (Stream C)	7/17/2008	0.23	24.08	8.03	8.15	408
Upper Crum Elbow Brook (Stream C)	8/26/2008	0.28	20.31	9.25	8.45	441
Upper Crum Elbow Brook (Stream C)	9/18/2008	0.40	17.86	9.74	8.19	429
Upper Crum Elbow Brook (Stream C)	10/9/2008	0.26	14.19	9.95	8.02	425
Upper Crum Elbow Brook (Stream C)	5/13/2009	0.50	15.42	10.35	8.27	349
Upper Crum Elbow Brook (Stream C)	6/23/2009	0.60	17.94	9.81	7.99	262
Upper Crum Elbow Brook (Stream C)	7/30/2009	0.29	21.33	8.82	8.07	401
Upper Crum Elbow Brook (Stream C)	8/26/2009	0.26	22.36	8.35	8.21	401

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data. 2006-2011 (continued).

Table A1. YSI sonde in-situ water quality measurements collected at ROVA (continued).

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Sp Cond (uS/cm)
Upper Crum Elbow Brook (Stream C)	9/23/2009	0.20	16.94	9.23	7.99	488
Upper Crum Elbow Brook (Stream C)	10/16/2009	0.25	7.19	11.58	8.56	472
Upper Crum Elbow Brook (Stream C)	5/13/2010	0.39	10.53	11.45	8.17	414
Upper Crum Elbow Brook (Stream C)	6/10/2010	0.10	16.77	9.08	8.12	440
Upper Crum Elbow Brook (Stream C)	6/10/2010	0.20	16.90	9.12	8.16	442
Upper Crum Elbow Brook (Stream C)	7/21/2010	0.13	24.70	7.46	8.06	536
Upper Crum Elbow Brook (Stream C)	8/26/2010	0.27	19.76	8.78	8.12	444
Upper Crum Elbow Brook (Stream C)	9/16/2010	0.20	15.19	9.26	8.04	631
Upper Crum Elbow Brook (Stream C)	10/13/2010	0.42	11.43	10.54	8.00	409
Upper Crum Elbow Brook (Stream C)	5/18/2011	0.36	14.41	10.50	8.06	313
Upper Crum Elbow Brook (Stream C)	6/17/2011	0.26	18.70	9.40	8.17	380
Upper Crum Elbow Brook (Stream C)	7/14/2011	0.43	22.26	8.74	8.35	431
Upper Crum Elbow Brook (Stream C)	8/11/2011	0.31	22.13	8.49	8.32	396
Upper Crum Elbow Brook (Stream C)	8/11/2011	0.32	22.06	8.67	8.28	398
Upper Crum Elbow Brook (Stream C)	9/14/2011	0.46	17.62	9.70	8.10	348
Upper Crum Elbow Brook (Stream C)	10/21/2011	0.66	12.32	10.77	8.06	306
Lower Crum Elbow Brook (Stream D)	5/24/2006	0.42	13.06	10.63	8.38	285
Lower Crum Elbow Brook (Stream D)	6/13/2006	0.00	21.19	10.02	8.61	164
Lower Crum Elbow Brook (Stream D)	6/21/2006	0.33	20.42	9.09	8.35	350
Lower Crum Elbow Brook (Stream D)	7/18/2006	0.26	24.59	8.41	8.28	389
Lower Crum Elbow Brook (Stream D)	8/16/2006	0.34	20.60	9.06	8.24	425
Lower Crum Elbow Brook (Stream D)	9/20/2006	0.22	16.93	9.58	8.21	311
Lower Crum Elbow Brook (Stream D)	10/18/2006	0.07	10.78	11.11	8.35	359
Lower Crum Elbow Brook (Stream D)	4/18/2007	0.75	7.05	12.27	8.00	200
Lower Crum Elbow Brook (Stream D)	5/23/2007	0.41	14.78	10.28	8.37	394
Lower Crum Elbow Brook (Stream D)	6/13/2007	0.31	20.49	9.01	8.29	453
Lower Crum Elbow Brook (Stream D)	7/11/2007	0.29	24.55	8.18	8.34	454
Lower Crum Elbow Brook (Stream D)	8/8/2007	0.21	23.34	8.41	8.23	494
Lower Crum Elbow Brook (Stream D)	9/6/2007	0.47	18.80	9.49	8.21	558
Lower Crum Elbow Brook (Stream D)	10/3/2007	0.13	16.57	10.22	8.30	597
Lower Crum Elbow Brook (Stream D)	10/3/2007	0.27	16.64	10.30	8.32	609
Lower Crum Elbow Brook (Stream D)	5/13/2008	0.57	14.61	10.03	8.28	371
Lower Crum Elbow Brook (Stream D)	6/12/2008	0.00	22.69	8.12	8.25	166
Lower Crum Elbow Brook (Stream D)	7/17/2008	0.30	23.75	8.39	8.35	424
Lower Crum Elbow Brook (Stream D)	8/27/2008	0.35	18.35	9.47	8.35	481
Lower Crum Elbow Brook (Stream D)	9/19/2008	0.51	15.23	10.09	8.29	480
Lower Crum Elbow Brook (Stream D)	10/9/2008	0.28	13.88	10.37	8.26	480
Lower Crum Elbow Brook (Stream D)	5/13/2009	0.45	15.43	10.27	8.35	359
Lower Crum Elbow Brook (Stream D)	6/23/2009	0.50	18.14	9.74	8.18	262
Lower Crum Elbow Brook (Stream D)	7/30/2009	0.26	21.37	8.91	8.22	405
Lower Crum Elbow Brook (Stream D)	8/26/2009	0.36	22.41	8.77	8.31	411
Lower Crum Elbow Brook (Stream D)	9/23/2009	0.21	16.77	10.05	8.25	521
Lower Crum Elbow Brook (Stream D)	10/16/2009	0.33	7.62	12.02	8.63	517
Lower Crum Elbow Brook (Stream D)	5/13/2010	0.36	10.52	11.55	8.33	444
Lower Crum Elbow Brook (Stream D)	5/13/2010	0.47	10.34	11.85	8.33	446
Lower Crum Elbow Brook (Stream D)	6/10/2010	0.25	16.48	9.94	8.48	485

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A1. YSI sonde in-situ water quality measurements collected at ROVA (continued).

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Sp Cond (uS/cm)
Lower Crum Elbow Brook (Stream D)	7/21/2010	0.28	24.52	7.92	8.10	561
Lower Crum Elbow Brook (Stream D)	8/26/2010	0.34	19.65	9.40	8.39	491
Lower Crum Elbow Brook (Stream D)	9/16/2010	0.32	14.85	10.42	8.34	717
Lower Crum Elbow Brook (Stream D)	10/13/2010	0.37	11.47	11.01	8.09	431
Lower Crum Elbow Brook (Stream D)	5/19/2011	0.43	14.89	10.41	8.21	299
Lower Crum Elbow Brook (Stream D)	6/16/2011	0.37	19.14	9.30	8.36	428
Lower Crum Elbow Brook (Stream D)	7/14/2011	0.55	23.47	8.48	8.43	450
Lower Crum Elbow Brook (Stream D)	8/11/2011	0.33	22.45	7.57	8.07	564
Lower Crum Elbow Brook (Stream D)	9/14/2011	0.48	17.77	9.73	8.30	352
Lower Crum Elbow Brook (Stream D)	10/21/2011	0.58	12.37	10.73	8.27	323
Maritje Kill (Stream E)	5/24/2006	0.32	13.60	10.09	8.00	377
Maritje Kill (Stream E)	6/21/2006	0.42	20.76	7.93	8.00	541
Maritje Kill (Stream E)	7/18/2006	0.28	23.63	7.36	7.96	578
Maritje Kill (Stream E)	8/16/2006	0.29	19.38	8.62	8.07	631
Maritje Kill (Stream E)	8/16/2006	0.33	19.32	8.65	8.02	630
Maritje Kill (Stream E)	9/20/2006	0.25	15.97	9.07	7.97	421
Maritje Kill (Stream E)	10/18/2006	0.19	11.28	9.26	7.91	450
Maritje Kill (Stream E)	4/17/2007	0.39	7.23	11.28	7.42	176
Maritje Kill (Stream E)	5/22/2007	0.23	15.15	9.11	8.03	548
Maritje Kill (Stream E)	6/12/2007	0.20	20.74	8.28	8.04	577
Maritje Kill (Stream E)	7/10/2007	0.18	25.58	7.44	7.79	639
Maritje Kill (Stream E)	8/8/2007	0.16	22.05	6.84	8.15	557
Maritje Kill (Stream E)	9/6/2007	0.30	16.42	8.85	8.29	436
Maritje Kill (Stream E)	10/3/2007	0.09	14.91	8.37	8.03	666
Maritje Kill (Stream E)	6/13/2008	0.30	17.80	8.69	8.08	640
Maritje Kill (Stream E)	7/18/2008	0.18	20.70	7.68	8.01	594
Maritje Kill (Stream E)	8/27/2008	0.20	15.00	9.37	8.23	659
Maritje Kill (Stream E)	9/19/2008	0.38	12.32	9.80	8.18	636
Maritje Kill (Stream E)	10/10/2008	0.27	12.22	8.87	7.93	653
Maritje Kill (Stream E)	5/13/2009	0.33	11.35	10.14	7.92	439
Maritje Kill (Stream E)	6/23/2009	0.89	20.14	7.95	7.65	339
Maritje Kill (Stream E)	7/30/2009	0.10	20.33	7.81	7.74	440
Maritje Kill (Stream E)	8/27/2009	0.14	18.46	8.24	7.97	517
Maritje Kill (Stream E)	9/22/2009	0.30	15.82	9.15	8.06	688
Maritje Kill (Stream E)	10/15/2009	0.24	6.80	11.63	8.11	662
Maritje Kill (Stream E)	5/13/2010	0.36	8.75	10.91	7.93	452
Maritje Kill (Stream E)	6/10/2010	0.17	14.43	9.50	8.21	598
Maritje Kill (Stream E)	7/22/2010	0.19	20.31	7.58	8.13	752
Maritje Kill (Stream E)	8/26/2010	0.32	18.67	8.20	8.00	626
Maritje Kill (Stream E)	9/15/2010	0.17	15.75	8.84	8.07	851
Maritje Kill (Stream E)	10/12/2010	0.31	13.96	9.16	7.76	626
Maritje Kill (Stream E)	5/18/2011	0.35	15.06	8.82	7.58	299
Maritje Kill (Stream E)	6/16/2011	0.17	18.51	8.50	8.02	565
Maritje Kill (Stream E)	7/13/2011	0.33	22.30	7.08	7.95	603
Maritje Kill (Stream E)	8/10/2011	0.13	21.60	8.05	8.04	581
Maritje Kill (Stream E)	8/10/2011	0.28	21.64	7.60	8.05	582

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A1. YSI sonde in-situ water quality measurements collected at ROVA (continued).

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Sp Cond (uS/cm)
Maritje Kill (Stream E)	9/13/2011	0.31	19.24	8.26	7.64	393
Maritje Kill (Stream E)	10/20/2011	0.19	13.30	8.62	7.50	380
Fall Kill (Stream F)	5/24/2006	0.41	16.26	12.00	8.07	327
Fall Kill (Stream F)	6/21/2006	0.21	23.69	12.71	8.35	393
Fall Kill (Stream F)	7/18/2006	0.19	27.71	7.55	7.68	453
Fall Kill (Stream F)	8/16/2006	0.23	22.06	5.44	7.61	571
Fall Kill (Stream F)	9/20/2006	0.17	18.44	7.24	7.68	389
Fall Kill (Stream F)	10/18/2006	0.07	12.01	7.08	7.74	410
Fall Kill (Stream F)	4/18/2007	0.83	7.10	11.52	8.08	187
Fall Kill (Stream F)	5/23/2007	0.31	20.26	17.80	9.17	410
Fall Kill (Stream F)	6/13/2007	0.21	21.56	7.35	7.81	501
Fall Kill (Stream F)	7/11/2007	0.13	26.81	4.85	7.44	534
Fall Kill (Stream F)	8/7/2007	0.16	26.63	4.52	7.24	624
Fall Kill (Stream F)	9/5/2007	0.21	20.55	5.25	7.28	633
Fall Kill (Stream F)	10/2/2007	0.07	16.23	5.58	7.30	677
Fall Kill (Stream F)	5/14/2008	0.44	11.65	7.28	7.46	384
Fall Kill (Stream F)	6/12/2008	0.12	27.65	10.28	8.12	558
Fall Kill (Stream F)	7/17/2008	0.28	27.92	9.09	7.83	395
Fall Kill (Stream F)	8/26/2008	0.36	23.91	11.92	8.04	574
Fall Kill (Stream F)	9/18/2008	0.31	17.33	9.52	7.66	518
Fall Kill (Stream F)	10/9/2008	0.26	17.74	12.97	8.05	532
Fall Kill (Stream F)	5/13/2009	0.52	12.84	9.38	7.63	368
Fall Kill (Stream F)	6/23/2009	0.41	20.27	8.43	7.46	276
Fall Kill (Stream F)	7/29/2009	0.34	22.30	7.60	7.59	391
Fall Kill (Stream F)	8/26/2009	0.23	23.93	8.59	7.72	438
Fall Kill (Stream F)	9/22/2009	0.11	17.04	9.47	7.63	622
Fall Kill (Stream F)	9/22/2009	0.17	17.14	9.22	7.65	623
Fall Kill (Stream F)	10/15/2009	0.32	8.00	8.06	7.72	616
Fall Kill (Stream F)	5/12/2010	0.35	10.91	9.35	7.55	438
Fall Kill (Stream F)	6/9/2010	0.22	16.39	6.58	7.62	618
Fall Kill (Stream F)	7/21/2010	0.17	30.67	8.85	7.92	756
Fall Kill (Stream F)	8/25/2010	0.32	21.03	7.52	5.13	755
Fall Kill (Stream F)	9/15/2010	0.18	21.02	8.00	7.85	808
Fall Kill (Stream F)	10/12/2010	0.33	16.15	7.84	7.24	580
Fall Kill (Stream F)	5/18/2011	0.29	15.53	9.87	7.54	308
Fall Kill (Stream F)	6/16/2011	0.27	22.19	10.84	7.97	415
Fall Kill (Stream F)	7/13/2011	0.33	26.46	7.80	7.66	458
Fall Kill (Stream F)	8/10/2011	0.22	25.52	9.27	7.72	531
Fall Kill (Stream F)	9/13/2011	0.24	19.03	7.46	7.28	322
Fall Kill (Stream F)	10/20/2011	0.31	12.82	6.88	7.34	344

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A2. Laboratory nutrient chemistry data for Roosevelt-Vanderbilt National Historic Sites. “<MRL” indicates the result was below the method reporting limit (provided after the abbreviation). *Missing values indicate data are unavailable.*

Site	Date	ANC (µeq/L)	App Color (PCU)	TP (µg/L)	TDP (µg/L)	SRP (µg/L)	TN (mg/L)	TDN (mg/L)	NO ₂ +NO ₃ (mg/L)	NO ₂ (mg/L)	NH ₃ (mg/L)
Lower FDR Brook (Stream A)	8/16/2006	2960.00	10	30		39	1.86		1.74	0.002	0.010
Lower FDR Brook (Stream A)	6/21/2006	2640.00	5	40		20	1.90		1.60	0.005	0.008
Lower FDR Brook (Stream A)	8/7/2007	3174.00	10	49	48	46	1.80	1.86	1.67	0.002	<MRL 0.02
Lower FDR Brook (Stream A)	5/23/2007	2666.21	5	27	19	17	2.62	2.59	2.29	0.005	<MRL 0.02
Lower FDR Brook (Stream A)	5/14/2008	2516.00	7	17	16	11	2.16	2.04	2.00	<MRL 0.005	
Lower FDR Brook (Stream A)	8/26/2008	2900.00	14	81	40	38	1.77	1.58	1.59	<MRL 0.005	<MRL 0.08
Lower FDR Brook (Stream A)	8/26/2009	2760.00	20	48	34	31	1.72	1.66	1.56	<MRL 0.005	<MRL 0.08
Lower FDR Brook (Stream A)	5/13/2009	2550.00	13	26	18	14	1.67	1.70	1.60	<MRL 0.005	<MRL 0.08
Lower FDR Brook (Stream A)	5/12/2010	2620.00	18	38	19	16	2.29	2.22	2.19	0.0052	<MRL 0.08
Lower FDR Brook (Stream A)	8/25/2010	2190.00	16	34	29	26	0.76	0.86	0.65	<MRL 0.005	<MRL 0.08
Lower FDR Brook (Stream A)	5/19/2011	1900.00	49	40	24	18	1.47	1.42	1.21	0.014	<MRL 0.08
Lower FDR Brook (Stream A)	8/11/2011	2810.00	13	42	31	27	2.38	2.28	0.21	<MRL 0.005	<MRL 0.08
Upper FDR Brook (Stream B)	8/16/2006	3340.00	10	50		55	2.69		2.52	0.001	0.007
Upper FDR Brook (Stream B)	5/23/2007		5	39	29	26	3.27	3.20	2.92	0.009	0.011
Upper FDR Brook (Stream B)	8/7/2007	3571.70	8	59	58	58	2.51	2.57	2.38	0.001	<MRL 0.02
Upper FDR Brook (Stream B)	8/26/2008	3580.00	9	64	41	38	2.25	2.24	2.32	<MRL 0.005	<MRL 0.08
Upper FDR Brook (Stream B)	5/14/2008	3100.00	11	22	19	13	2.76	2.50	2.75	0.007	
Upper FDR Brook (Stream B)	5/13/2009	3040.00	14	28	24	16	2.04	2.05	1.93	0.009	<MRL 0.08
Upper FDR Brook (Stream B)	8/26/2009	3350.00	15	44	39	36	2.77	2.54	2.51	<MRL 0.005	<MRL 0.08
Upper FDR Brook (Stream B)	8/25/2010	2760.00	21	50	43	38	2.62	2.84	2.46	0.006	<MRL 0.08
Upper FDR Brook (Stream B)	5/12/2010	2810.00	23	35	22	20	2.82	2.87	2.80	0.010	<MRL 0.08
Upper FDR Brook (Stream B)	5/19/2011	2180.00	64	62	33	25	1.84	1.70	1.40	0.029	<MRL 0.08

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A2. Laboratory nutrient chemistry data for Roosevelt-Vanderbilt National Historic Sites (continued).

Site	Date	ANC (µeq/L)	App Color (PCU)	TP (µg/L)	TDP (µg/L)	SRP (µg/L)	TN (mg/L)	TDN (mg/L)	NO ₂ +NO ₃ (mg/L)	NO ₂ (mg/L)	NH ₃ (mg/L)
Upper FDR Brook (Stream B)	8/11/2011	3240.00	14	44	40	38	3.13	3.05	0.30	0.0076	<MRL 0.08
Upper Crum Elbow Brook (Stream C)	8/16/2006	2440.00	18	40		24	0.67		0.45	0.002	0.014
Upper Crum Elbow Brook (Stream C)	6/21/2006	2040.00	15	30		14	0.69		0.37	0.004	0.019
Upper Crum Elbow Brook (Stream C)	5/23/2007	2219.96	10	29	16	13	0.89	0.85	0.66	0.007	0.023
Upper Crum Elbow Brook (Stream C)	5/13/2008	1974.00	29	22	16	10	0.46	0.48	0.28	<MRL 0.005	
Upper Crum Elbow Brook (Stream C)	8/26/2008	2330.00	19	41	32	27	0.56	0.54	0.38	<MRL 0.005	<MRL 0.08
Upper Crum Elbow Brook (Stream C)	5/13/2009	1890.00	32	26	16	12	0.47	0.51	0.26	<MRL 0.005	<MRL 0.08
Upper Crum Elbow Brook (Stream C)	8/26/2009	2340.00	31	41	31	27	0.67	0.62	0.40	<MRL 0.005	<MRL 0.08
Upper Crum Elbow Brook (Stream C)	5/13/2010	2270.00	25	27	18	15	0.68	0.68	0.53	0.0059	<MRL 0.08
Upper Crum Elbow Brook (Stream C)	8/26/2010	2000.00	29	59	46	39	0.64	0.68	0.41	<MRL 0.005	<MRL 0.08
Upper Crum Elbow Brook (Stream C)	8/11/2011	2230.00	27	46	41	33	0.63	0.64	0.32	<MRL 0.005	<MRL 0.08
Upper Crum Elbow Brook (Stream C)	5/18/2011	1750.00	68	38	18	9	0.62	0.55	0.28	0.006	<MRL 0.08
Lower Crum Elbow Brook (Stream D)	6/21/2006	2100.00	18	30		17	0.81		0.49	0.006	0.02
Lower Crum Elbow Brook (Stream D)	8/16/2006	2380.00	15	30		26	0.89		0.66	0.003	0.01
Lower Crum Elbow Brook (Stream D)	8/8/2007	2328.90	15	49	31	25	1.33	1.27	1.03	0.007	<MRL 0.02
Lower Crum Elbow Brook (Stream D)	5/23/2007	2259.84	13	26	15	13	1.05	1.01	0.78	0.007	0.016
Lower Crum Elbow Brook (Stream D)	8/27/2008	2400.00	20	33	27	22	0.76	0.74	0.54	<MRL 0.005	<MRL 0.08
Lower Crum Elbow Brook (Stream D)	5/13/2008	1998.00	26	22	16	9	0.56	0.62	0.40	0.0053	
Lower Crum Elbow Brook (Stream D)	8/26/2009	2400.00	37	42	32	28	0.80	0.79	0.51	<MRL 0.005	<MRL 0.08
Lower Crum Elbow Brook (Stream D)	5/13/2009	1900.00	34	27	18	13	0.57	0.56	0.34	<MRL 0.005	<MRL 0.08
Lower Crum Elbow Brook (Stream D)	5/13/2010	2310.00	25	28	20	16	0.85	0.83	0.70	0.0063	<MRL 0.08
Lower Crum Elbow Brook (Stream D)	8/11/2011	2830.00	29	60	40	35	1.36	1.23	0.93	0.0081	<MRL 0.08
Maritje Kill (Stream E)	8/16/2006	3720.00	13	40		46	1.16		0.98	0.001	0.01
Maritje Kill (Stream E)	8/8/2007	3188.20	15	63	50	48	1.23	1.18	0.93	0.006	0.023

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A2. Laboratory nutrient chemistry data for Roosevelt-Vanderbilt National Historic Sites (continued).

Site	Date	ANC (µeq/L)	App Color (PCU)	TP (µg/L)	TDP (µg/L)	SRP (µg/L)	TN (mg/L)	TDN (mg/L)	NO ₂ +NO ₃ (mg/L)	NO ₂ (mg/L)	NH ₃ (mg/L)
Maritje Kill (Stream E)	8/8/2007	3198.40	15	63	50	48	1.23	1.18	0.93	0.006	0.023
Maritje Kill (Stream E)	5/23/2007	3330.29	8	36	26	21	1.32	1.40	1.11	0.013	0.015
Maritje Kill (Stream E)	8/27/2008	3830.00	11	54	43	43	1.09	1.07	0.96	<MRL 0.005	<MRL 0.08
Maritje Kill (Stream E)	5/13/2009	2630.00	35	32	21	14	0.63	0.60	0.37	<MRL 0.005	<MRL 0.08
Maritje Kill (Stream E)	8/27/2009	3160.00	25	38	28	25	1.01	0.98	0.74	<MRL 0.005	<MRL 0.08
Maritje Kill (Stream E)	5/13/2010	2770.00	38	39	20	17	0.73	0.66	0.53	0.005	<MRL 0.08
Maritje Kill (Stream E)	8/10/2011	3230.00	21	45	37	32	0.87	0.84	0.56	<MRL 0.005	<MRL 0.08
Maritje Kill (Stream E)	5/18/2011	1820.00	77	44	16	5	0.48	0.43	0.11	<MRL 0.005	<MRL 0.08
Fall Kill (Stream F)	8/7/2007	2744.20	18	111	58	52	0.48	0.35	0.01	0.001	0.033
Fall Kill (Stream F)	5/23/2007	2034.43	20	56	31	21	0.72	0.69	0.39	0.010	0.028
Fall Kill (Stream F)	5/14/2008	1818.00	35	35	21	15	0.50	0.44	0.25	<MRL 0.005	
Fall Kill (Stream F)	8/26/2008	2610.00	49	70	18	13	0.72	0.59	0.35	0.008	<MRL 0.08
Fall Kill (Stream F)	8/26/2009	2260.00	50	76	50	44	0.77	0.68	0.32	0.006	<MRL 0.08
Fall Kill (Stream F)	5/13/2009	1750.00	44	44	28	21	0.54	0.50	0.27	<MRL 0.005	<MRL 0.08
Fall Kill (Stream F)	8/25/2010	2270.00	64	95	41	30	0.92	0.78	0.39	0.009	0.100
Fall Kill (Stream F)	5/12/2010	1950.00	54	66	34	27	0.69	0.62	0.41	0.008	<MRL 0.08
Fall Kill (Stream F)	8/10/2011	2070.00	46	91	52	42	0.78	0.70	0.32	0.006	<MRL 0.08
Fall Kill (Stream F)	5/18/2011	1470.00	80	65	31	17	0.61	0.52	0.18	0.005	<MRL 0.08

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for Roosevelt-Vanderbilt National Historic Sites. *Missing values indicate data are unavailable.*

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Lower FDR Brook (Stream A)	6/21/2006	2.48	1.53	0.47	0.73
Lower FDR Brook (Stream A)	7/18/2006	2.47	0.69	0.88	0.64
Lower FDR Brook (Stream A)	8/16/2006	2.52	0.47	0.83	0.37
Lower FDR Brook (Stream A)	9/20/2006	2.42	0.89	0.78	0.69
Lower FDR Brook (Stream A)	10/18/2006	2.39	1.97	0.54	1.00
Lower FDR Brook (Stream A)	4/18/2007		3.18	1.52	4.95
Lower FDR Brook (Stream A)	5/23/2007	2.31	0.98	0.99	0.96
Lower FDR Brook (Stream A)	6/13/2007	2.34	0.68	1.09	0.67
Lower FDR Brook (Stream A)	7/11/2007	2.38	0.49	0.84	0.44
Lower FDR Brook (Stream A)	8/7/2007	2.27	0.48	0.49	0.23
Lower FDR Brook (Stream A)	9/5/2007	2.34	0.59	0.27	0.14
Lower FDR Brook (Stream A)	10/2/2007		0.72	0.24	0.16
Lower FDR Brook (Stream A)	5/14/2008	1.40	1.02	0.87	0.90
Lower FDR Brook (Stream A)	6/12/2008	1.46	0.45	0.87	0.39
Lower FDR Brook (Stream A)	7/18/2008	1.46	0.69	0.59	0.43
Lower FDR Brook (Stream A)	8/26/2008	1.48			
Lower FDR Brook (Stream A)	9/18/2008	1.42	1.79	0.23	0.48
Lower FDR Brook (Stream A)	10/10/2008	1.46	2.53	0.18	0.48
Lower FDR Brook (Stream A)	5/13/2009	1.10	2.82	0.39	1.11
Lower FDR Brook (Stream A)	6/23/2009	1.15	2.74	0.77	2.11
Lower FDR Brook (Stream A)	7/29/2009	1.20	1.56	0.22	0.35
Lower FDR Brook (Stream A)	8/26/2009	1.38	1.44	0.60	0.81
Lower FDR Brook (Stream A)	9/22/2009	1.40	0.92	0.49	0.45
Lower FDR Brook (Stream A)	10/15/2009	1.42	1.17	0.38	0.44
Lower FDR Brook (Stream A)	5/12/2010	1.16	1.32	0.87	1.15
Lower FDR Brook (Stream A)	6/9/2010	1.27	0.76	0.81	0.62
Lower FDR Brook (Stream A)	7/21/2010	1.08	1.01	0.29	0.29
Lower FDR Brook (Stream A)	8/25/2010	0.90	3.28	1.29	4.22
Lower FDR Brook (Stream A)	9/15/2010	1.27	1.79	0.09	0.15
Lower FDR Brook (Stream A)	10/12/2010	1.23	1.71	0.21	0.36
Lower FDR Brook (Stream A)	5/19/2011	0.78	3.30	1.02	3.36
Lower FDR Brook (Stream A)	6/17/2011	0.87	2.78	0.85	2.37
Lower FDR Brook (Stream A)	7/14/2011	0.94	2.83	0.35	0.99
Lower FDR Brook (Stream A)	8/11/2011	0.28	3.88	0.03	0.13
Lower FDR Brook (Stream A)	9/13/2011	0.18	2.90	0.90	2.60
Lower FDR Brook (Stream A)	10/20/2011	0.03	3.00	0.62	1.85
Upper FDR Brook (Stream B)	6/21/2006		0.76	0.36	0.34
Upper FDR Brook (Stream B)	7/18/2006	1.18	0.48	0.51	0.25
Upper FDR Brook (Stream B)	8/16/2006	1.18	0.48	0.48	0.24

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for Roosevelt-Vanderbilt National Historic Sites (continued).

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Upper FDR Brook (Stream B)	9/20/2006	1.10	0.57	0.61	0.36
Upper FDR Brook (Stream B)	10/18/2006	1.04	0.58	0.82	0.45
Upper FDR Brook (Stream B)	4/18/2007	0.85	2.03	1.65	3.45
Upper FDR Brook (Stream B)	5/23/2007	1.14	1.01	0.52	0.54
Upper FDR Brook (Stream B)	6/13/2007	1.20	0.72	0.41	0.33
Upper FDR Brook (Stream B)	7/11/2007	1.33	0.50	0.38	0.20
Upper FDR Brook (Stream B)	8/7/2007	1.29	0.59	0.31	0.20
Upper FDR Brook (Stream B)	9/5/2007	1.27	0.36	0.39	0.13
Upper FDR Brook (Stream B)	10/2/2007	1.27	3.16	0.27	0.77
Upper FDR Brook (Stream B)	5/14/2008	1.17	0.84	0.61	0.46
Upper FDR Brook (Stream B)	6/12/2008	1.21	0.76	0.28	0.22
Upper FDR Brook (Stream B)	7/18/2008	1.27	1.10	0.24	0.24
Upper FDR Brook (Stream B)	8/26/2008	1.29			
Upper FDR Brook (Stream B)	9/18/2008	1.29		0.24	
Upper FDR Brook (Stream B)	10/10/2008	1.25	1.18	0.20	0.25
Upper FDR Brook (Stream B)	5/13/2009	1.16	2.02	0.24	0.48
Upper FDR Brook (Stream B)	6/23/2009	1.04	2.19	0.45	0.98
Upper FDR Brook (Stream B)	7/29/2009				
Upper FDR Brook (Stream B)	8/26/2009	1.21	1.53	0.31	0.43
Upper FDR Brook (Stream B)	9/22/2009	2.08	1.53	0.15	0.23
Upper FDR Brook (Stream B)	10/15/2009	1.20	1.90	0.17	0.35
Upper FDR Brook (Stream B)	5/12/2010	1.18	1.37	0.46	0.64
Upper FDR Brook (Stream B)	6/9/2010		1.28	0.42	0.54
Upper FDR Brook (Stream B)	7/22/2010	1.30	1.07	0.20	0.22
Upper FDR Brook (Stream B)	8/25/2010	1.33	0.92	0.31	0.28
Upper FDR Brook (Stream B)	9/15/2010	1.42	1.02	0.12	0.12
Upper FDR Brook (Stream B)	10/12/2010	1.31	1.16	0.22	0.25
Upper FDR Brook (Stream B)	5/19/2011	1.04	1.92	1.27	2.43
Upper FDR Brook (Stream B)	6/17/2011	1.11	1.97	0.56	1.11
Upper FDR Brook (Stream B)	7/14/2011	1.21	0.16	0.09	0.01
Upper FDR Brook (Stream B)	8/11/2011	0.17	0.92	0.37	0.34
Upper FDR Brook (Stream B)	9/13/2011	1.21	2.84	0.50	1.42
Upper FDR Brook (Stream B)	10/20/2011	1.26	3.02	0.29	0.87
Upper Crum Elbow Brook (Stream C)	6/21/2006		11.32	1.46	17.36
Upper Crum Elbow Brook (Stream C)	7/18/2006	2.94	20.71	0.37	8.23
Upper Crum Elbow Brook (Stream C)	8/16/2006	2.25	18.24	0.21	3.86
Upper Crum Elbow Brook (Stream C)	9/20/2006	2.73	24.04	0.86	21.76
Upper Crum Elbow Brook (Stream C)	10/18/2006	2.88	21.89	0.70	15.01
Upper Crum Elbow Brook (Stream C)	4/18/2007		tapedown submerged		
Upper Crum Elbow Brook (Stream C)	5/23/2007	1.07	23.09	0.64	12.97
Upper Crum Elbow Brook (Stream C)	6/13/2007	1.13	23.41	0.39	7.39

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for Roosevelt-Vanderbilt National Historic Sites (continued).

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Upper Crum Elbow Brook (Stream C)	7/11/2007	1.21	45.36	0.16	4.47
Upper Crum Elbow Brook (Stream C)	8/8/2007				
Upper Crum Elbow Brook (Stream C)	10/3/2007	1.21			
Upper Crum Elbow Brook (Stream C)	5/13/2008	0.38	11.51	1.63	17.98
Upper Crum Elbow Brook (Stream C)	6/12/2008	0.50	11.33	0.79	7.77
Upper Crum Elbow Brook (Stream C)	7/17/2008	1.22	17.13	0.68	9.91
Upper Crum Elbow Brook (Stream C)	8/26/2008	1.54			
Upper Crum Elbow Brook (Stream C)	9/18/2008	1.04		0.37	
Upper Crum Elbow Brook (Stream C)	10/9/2008	1.12	16.58	0.35	4.66
Upper Crum Elbow Brook (Stream C)	5/13/2009	0.76	21.36	1.10	23.59
Upper Crum Elbow Brook (Stream C)	6/23/2009				
Upper Crum Elbow Brook (Stream C)	7/30/2009	0.79	1.07	21.49	23.00
Upper Crum Elbow Brook (Stream C)	8/26/2009	0.92	19.78	0.91	16.12
Upper Crum Elbow Brook (Stream C)	9/23/2009	1.08	17.01	0.25	4.18
Upper Crum Elbow Brook (Stream C)	10/16/2009	1.05	23.88	0.15	3.54
Upper Crum Elbow Brook (Stream C)	5/13/2010	0.93	21.72	0.55	11.91
Upper Crum Elbow Brook (Stream C)	6/10/2010		21.88	0.24	5.22
Upper Crum Elbow Brook (Stream C)	7/21/2010		3.75	0.33	1.22
Upper Crum Elbow Brook (Stream C)	8/26/2010	1.20	6.18	0.77	4.76
Upper Crum Elbow Brook (Stream C)	9/16/2010	1.25	1.96	0.36	0.70
Upper Crum Elbow Brook (Stream C)	10/13/2010	1.00	26.96	0.35	9.48
Upper Crum Elbow Brook (Stream C)	5/18/2011		24.43	2.63	64.44
Upper Crum Elbow Brook (Stream C)	6/17/2011	0.50	17.12	1.08	18.41
Upper Crum Elbow Brook (Stream C)	7/14/2011	0.64	10.22	1.01	10.36
Upper Crum Elbow Brook (Stream C)	8/11/2011	1.06	10.05	0.80	8.00
Lower Crum Elbow Brook (Stream D)	6/21/2006	N/A	17.64	0.82	15.32
Lower Crum Elbow Brook (Stream D)	7/18/2006	2.28	14.77	0.60	10.17
Lower Crum Elbow Brook (Stream D)	8/16/2006	2.44	17.70	0.25	4.29
Lower Crum Elbow Brook (Stream D)	9/20/2006	2.01	17.96	1.31	23.67
Lower Crum Elbow Brook (Stream D)	10/18/2006	2.10	15.27	1.09	16.38
Lower Crum Elbow Brook (Stream D)	4/18/2007		tapedown submerged		
Lower Crum Elbow Brook (Stream D)	5/23/2007	2.23	19.45	0.74	13.92
Lower Crum Elbow Brook (Stream D)	6/13/2007	2.38			
Lower Crum Elbow Brook (Stream D)	7/11/2007	2.48	2.41	1.24	2.96
Lower Crum Elbow Brook (Stream D)	8/7/2007				
Lower Crum Elbow Brook (Stream D)	8/8/2007	2.33	2.83	0.86	2.51
Lower Crum Elbow Brook (Stream D)	9/6/2007	2.58	2.08	0.65	1.32
Lower Crum Elbow Brook (Stream D)	10/3/2007	2.59	1.63	0.57	0.86
Lower Crum Elbow Brook (Stream D)	5/13/2008	1.88	17.67	1.10	18.26
Lower Crum Elbow Brook (Stream D)	6/12/2008	2.32	11.66	0.79	7.86
Lower Crum Elbow Brook (Stream D)	7/17/2008	2.25	12.21	0.89	10.74

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for Roosevelt-Vanderbilt National Historic Sites (continued).

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Lower Crum Elbow Brook (Stream D)	8/27/2008	2.58			
Lower Crum Elbow Brook (Stream D)	9/19/2008	2.96		0.59	
Lower Crum Elbow Brook (Stream D)	10/9/2008	2.54			
Lower Crum Elbow Brook (Stream D)	5/13/2009	2.02	25.00	1.53	28.35
Lower Crum Elbow Brook (Stream D)	6/23/2009				
Lower Crum Elbow Brook (Stream D)	7/30/2009	2.12	19.95	1.22	24.29
Lower Crum Elbow Brook (Stream D)	8/26/2009	1.94	22.11	0.67	14.96
Lower Crum Elbow Brook (Stream D)	9/23/2009	2.58	9.98	0.43	4.32
Lower Crum Elbow Brook (Stream D)	10/16/2009	2.95	17.12	0.19	3.25
Lower Crum Elbow Brook (Stream D)	5/13/2010	2.20	17.23	0.90	15.43
Lower Crum Elbow Brook (Stream D)	6/10/2010	2.54	9.34	0.65	6.03
Lower Crum Elbow Brook (Stream D)	7/21/2010	2.60	2.27	0.70	1.58
Lower Crum Elbow Brook (Stream D)	9/16/2010		2.13	0.23	0.48
Lower Crum Elbow Brook (Stream D)	10/13/2010	2.38	21.59	0.53	11.41
Lower Crum Elbow Brook (Stream D)	6/16/2011	2.21	19.56	0.79	15.41
Lower Crum Elbow Brook (Stream D)	7/14/2011	2.32	24.69	0.45	11.09
Lower Crum Elbow Brook (Stream D)	8/11/2011		0.00	0.00	0.00
Maritje Kill (Stream E)	6/21/2006		3.52	0.33	1.39
Maritje Kill (Stream E)	7/18/2006	2.82	3.65	0.28	1.16
Maritje Kill (Stream E)	8/16/2006	2.98	1.68	0.29	0.54
Maritje Kill (Stream E)	9/20/2006	2.60	5.47	0.28	1.64
Maritje Kill (Stream E)	10/18/2006	2.32	8.11	0.29	2.45
Maritje Kill (Stream E)	4/17/2007				
Maritje Kill (Stream E)	5/22/2007				
Maritje Kill (Stream E)	5/23/2007	2.88	2.61	0.44	1.14
Maritje Kill (Stream E)	6/12/2007	3.00	1.84	0.44	0.75
Maritje Kill (Stream E)	7/10/2007	3.15	0.85	0.29	0.26
Maritje Kill (Stream E)	8/7/2007				
Maritje Kill (Stream E)	8/8/2007	3.10	1.20	0.33	0.38
Maritje Kill (Stream E)	9/6/2007	3.17	0.67	0.22	0.14
Maritje Kill (Stream E)	10/3/2007	3.19	1.31	0.12	0.13
Maritje Kill (Stream E)	6/13/2008	2.88	2.32	0.25	0.61
Maritje Kill (Stream E)	7/18/2008	2.83	2.62	0.25	0.71
Maritje Kill (Stream E)	8/27/2008	2.96			
Maritje Kill (Stream E)	9/19/2008	2.92		0.38	
Maritje Kill (Stream E)	10/10/2008	2.90	2.26	0.27	0.68
Maritje Kill (Stream E)	5/13/2009	2.40	8.49	0.42	3.60
Maritje Kill (Stream E)	6/23/2009	1.68	14.41	1.10	15.81
Maritje Kill (Stream E)	7/30/2009	2.52	4.93	0.65	3.19
Maritje Kill (Stream E)	8/27/2009	2.77	0.10	0.45	1.32
Maritje Kill (Stream E)	9/22/2009	2.95	2.79	0.12	0.33

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for Roosevelt-Vanderbilt National Historic Sites (continued).

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Maritje Kill (Stream E)	10/15/2009	2.90	1.74	0.16	0.31
Maritje Kill (Stream E)	5/13/2010	2.80	6.00	0.29	1.75
Maritje Kill (Stream E)	6/10/2010	2.85	4.78	0.22	1.04
Maritje Kill (Stream E)	7/22/2010	3.10	2.84	0.06	0.16
Maritje Kill (Stream E)	5/18/2011	1.79	19.16	0.78	14.97
Maritje Kill (Stream E)	6/16/2011	2.90	3.32	0.39	1.40
Maritje Kill (Stream E)	7/13/2011	2.92	4.65	0.19	1.09
Maritje Kill (Stream E)	8/10/2011	2.68	3.88	0.27	1.25
Maritje Kill (Stream E)	9/13/2011		8.22	0.85	7.68
Maritje Kill (Stream E)	10/20/2011	1.95	14.18	0.47	6.69
Fall Kill (Stream F)	6/21/2006		3.58	0.75	2.68
Fall Kill (Stream F)	7/18/2006	1.71	3.58	1.06	3.95
Fall Kill (Stream F)	9/20/2006	1.59	3.90	0.99	4.05
Fall Kill (Stream F)	10/18/2006	1.58	4.12	0.94	4.28
Fall Kill (Stream F)	4/18/2007		tapedown submerged		
Fall Kill (Stream F)	5/23/2007	1.70	4.01	1.28	5.39
Fall Kill (Stream F)	6/13/2007	1.71	1.60	1.58	2.61
Fall Kill (Stream F)	7/11/2007	1.81	0.81	1.07	0.93
Fall Kill (Stream F)	8/7/2007	dry	0.38	0.90	0.33
Fall Kill (Stream F)	9/5/2007	dry	0.44	0.85	0.35
Fall Kill (Stream F)	10/2/2007	dry	0.50	0.66	0.34
Fall Kill (Stream F)	5/14/2008	0.96	6.27	1.51	9.51
Fall Kill (Stream F)	6/12/2008	1.10	3.08	0.68	2.08
Fall Kill (Stream F)	7/17/2008	1.08	3.54	1.10	3.90
Fall Kill (Stream F)	8/26/2008		dry		
Fall Kill (Stream F)	9/18/2008	1.08		0.97	
Fall Kill (Stream F)	10/9/2008	1.13	3.05	0.79	2.41
Fall Kill (Stream F)	5/13/2009	0.84	6.96	1.91	13.29
Fall Kill (Stream F)	6/23/2009	-0.24	19.47	4.30	83.73
Fall Kill (Stream F)	7/29/2009	0.88	6.93	1.81	12.55
Fall Kill (Stream F)	8/26/2009	1.00	5.17	1.40	7.24
Fall Kill (Stream F)	9/22/2009		2.25	0.83	1.86
Fall Kill (Stream F)	10/15/2009	1.10	3.51	1.16	4.08
Fall Kill (Stream F)	5/12/2010	1.00	1.42	0.27	0.39
Fall Kill (Stream F)	6/9/2010	1.16	2.29	1.01	2.31
Fall Kill (Stream F)	8/25/2010	1.10	2.51	0.91	2.28
Fall Kill (Stream F)	9/15/2010		11.74	0.06	0.76
Fall Kill (Stream F)	10/12/2010	1.06	3.58	1.22	4.36
Fall Kill (Stream F)	5/18/2011	0.23	13.35	3.84	51.27
Fall Kill (Stream F)	6/16/2011	1.02	4.67	1.44	6.72
Fall Kill (Stream F)	7/13/2011	1.08	3.45	1.20	4.14

Appendix A. Roosevelt-Vanderbilt National Historic Sites (ROVA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for Roosevelt-Vanderbilt National Historic Sites (continued).

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Fall Kill (Stream F)	8/10/2011	-0.28	4.35	1.34	5.83
Fall Kill (Stream F)	9/13/2011		14.04	3.71	52.08
Fall Kill (Stream F)	10/20/2011	0.37	9.82	2.78	27.31

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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